2671 F1

(12) UK Patent Application (19) GB (11) 2 111 244 A

(21) Application No **8228548**
(22) Date of filing **6 Oct 1982**
(30) Priority data
(31) **56/158739**
(32) **7 Oct 1981**
(33) **Japan (JP)**
(43) Application published
29 Jun 1983
(51) **INT CL³**
B66B 1/20
(52) Domestic classification
G3N BA3
U1S 1872 G3N
(56) Documents cited
None
(58) Field of search
G3N

(71) Applicant
Hitachi Ltd.
(Japan),
5—1 Marunouchi 1-chome, Chiyoda-ku, Tokyo, Japan
(72) Inventors
Soshiro Kuzunuki,
Kotaro Hirasawa,
Kenichi Kurosawa,
Takashi Kaneko
(74) Agent and/or Address for Service
Mewburn Ellis and Co.,
2/3 Cursitor Street,
London EC4A 1BQ

(54) Control system for group-controlling lift cars

(57) A control system for group-controlling lift cars has means (M_1) for selecting a car to serve a hall call as a function of a waiting time and a power consumption and an evaluation function having a variable parameter α for varying the relative weights of the waiting time and the power consumption, and simulation means (M_2) equivalent to the car selection means. M_2 computes a variable parameter α_1, α_2 which satisfies an instructed power consumption target value P_m and selects a car to serve the hall call based on the computed variable parameter α_1, α_2 so that a highly efficient lift car service is provided.

FIG. 1

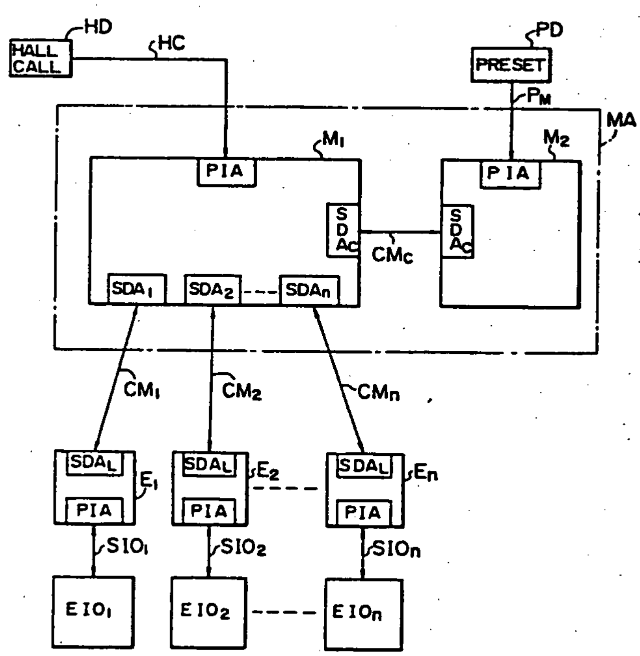
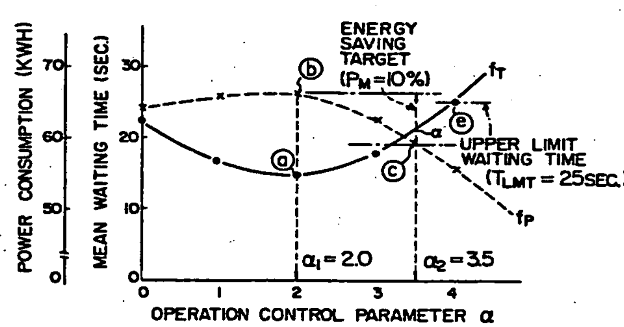


FIG. 10



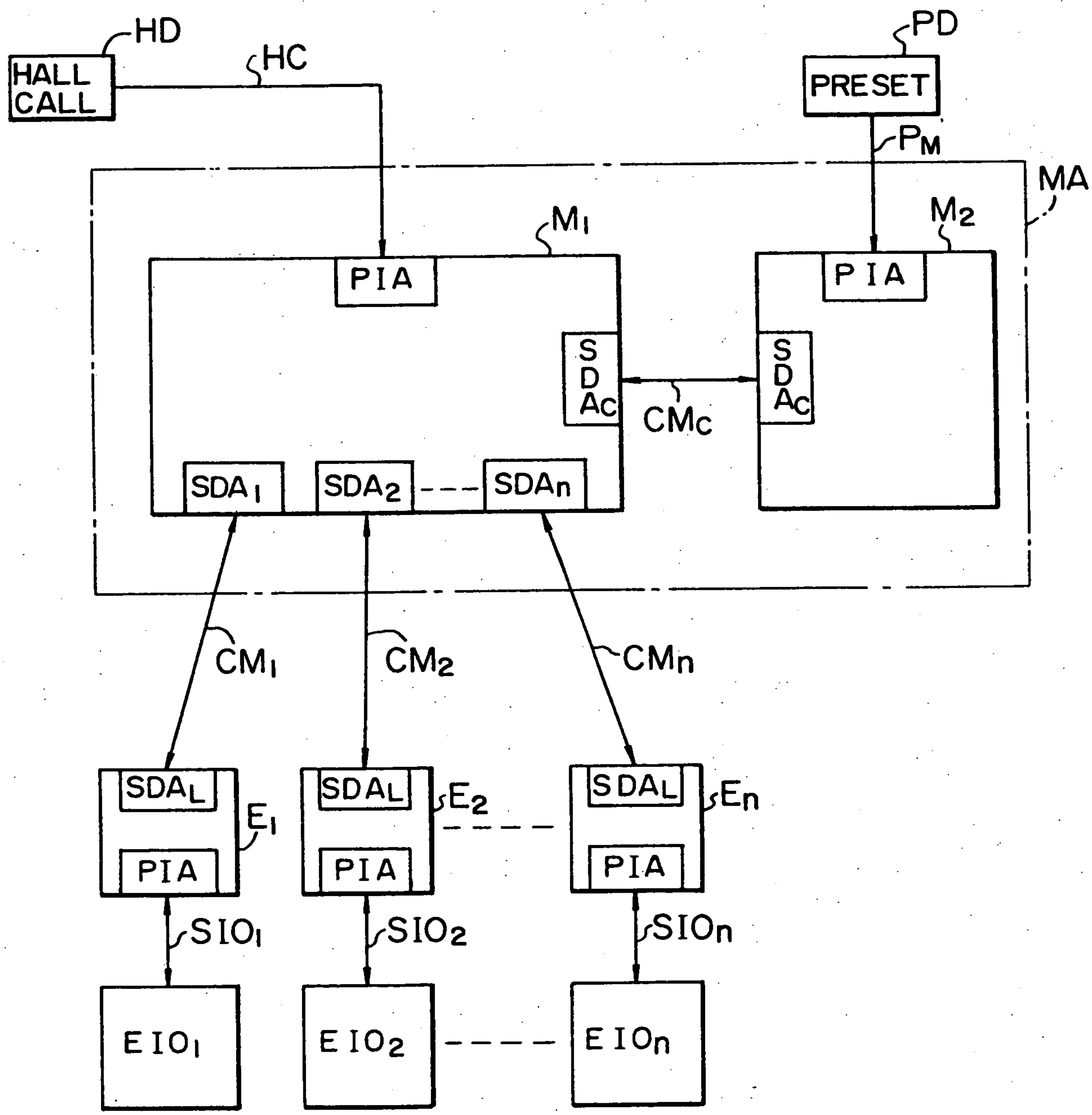
The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

GB 2 111 244 A

2111244

1/18

FIG. 1



2111244

3/18

FIG. 3

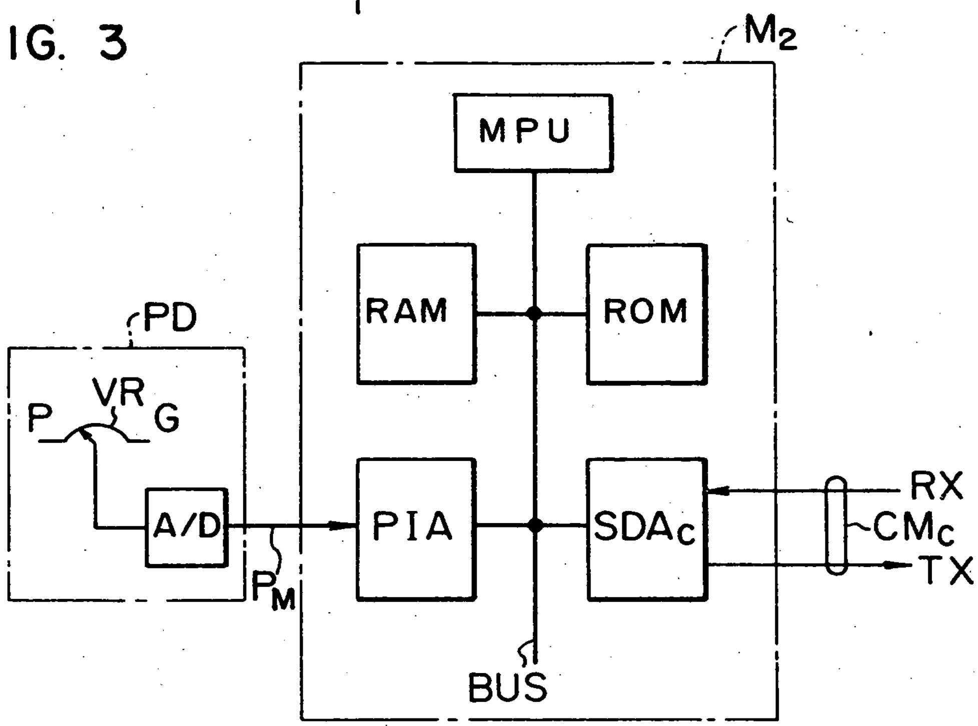


FIG. 4

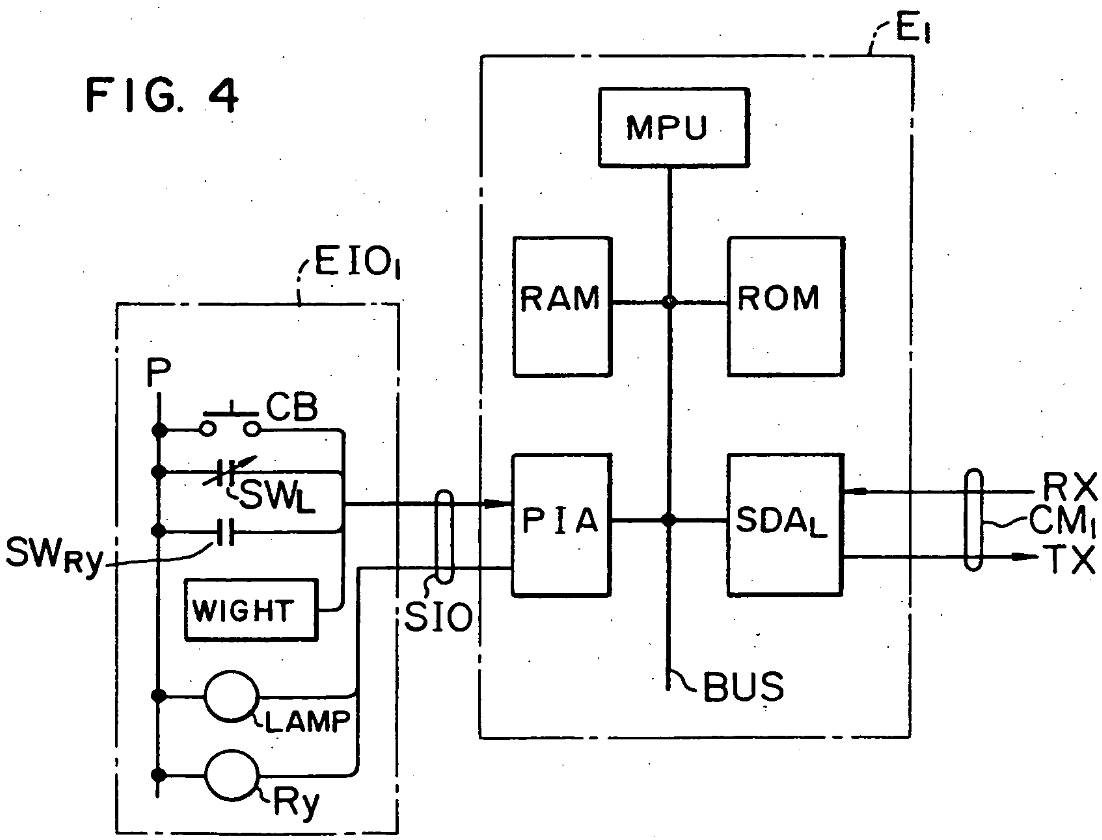


FIG. 5

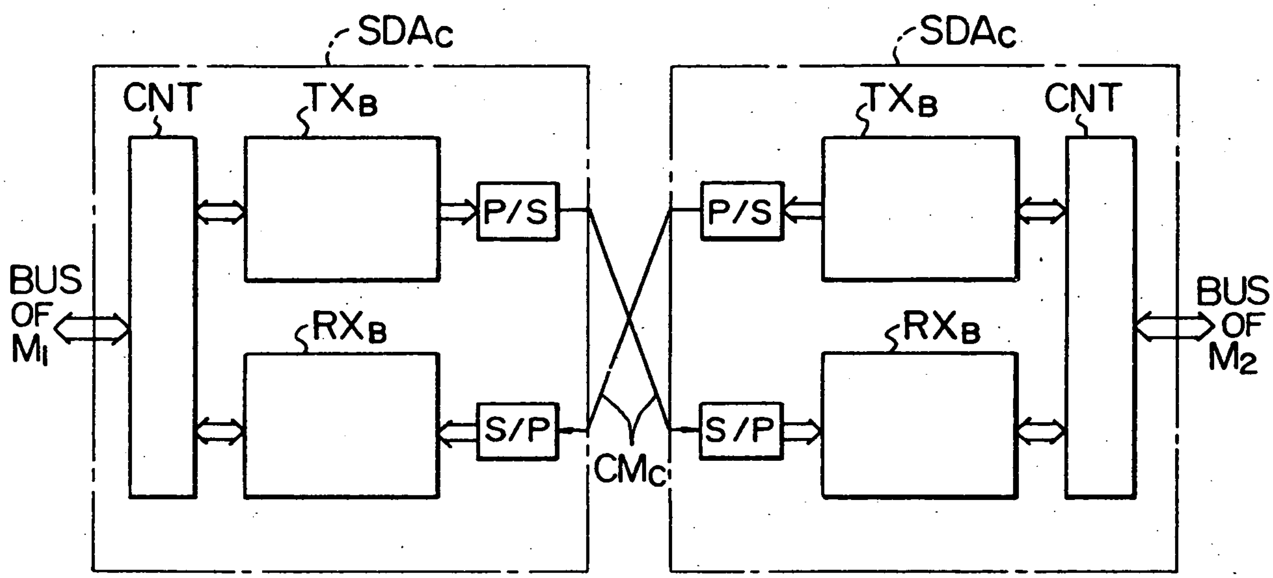

SDAc
CNT
TX_B
P/S
BUS OF M_1
RX_B
S/P
CM_C
SDAc
TX_B
CNT
P/S
BUS OF M_2
RX_B
S/P

FIG. 7

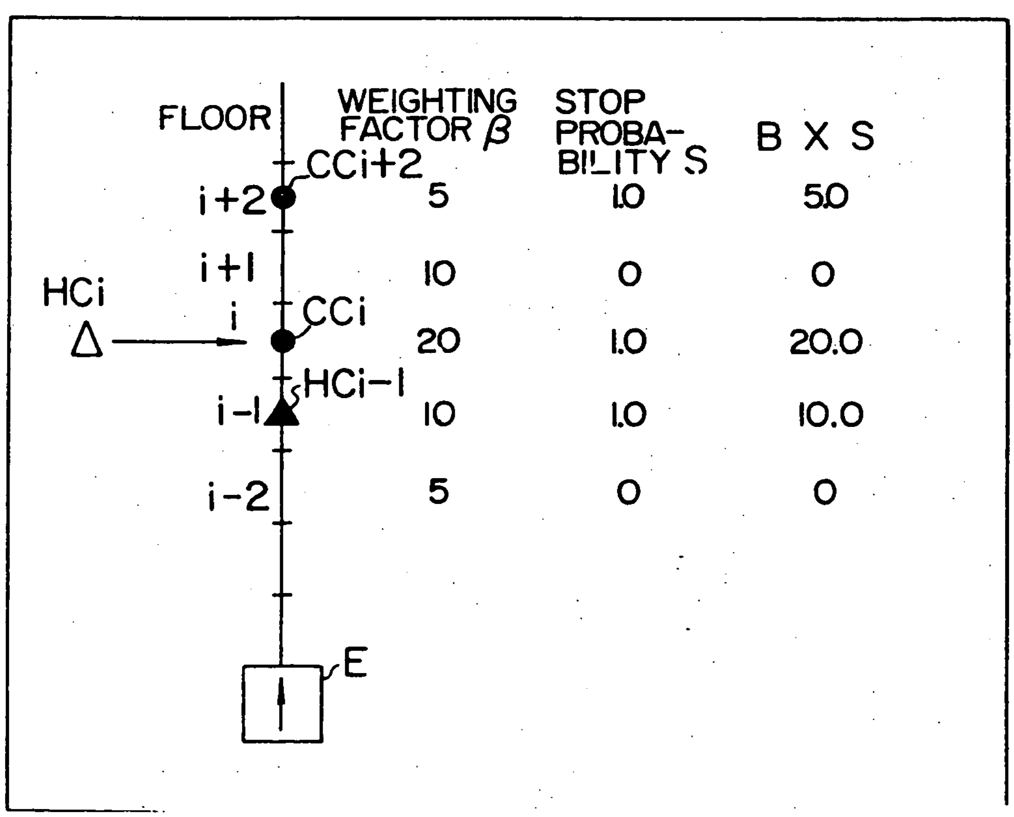
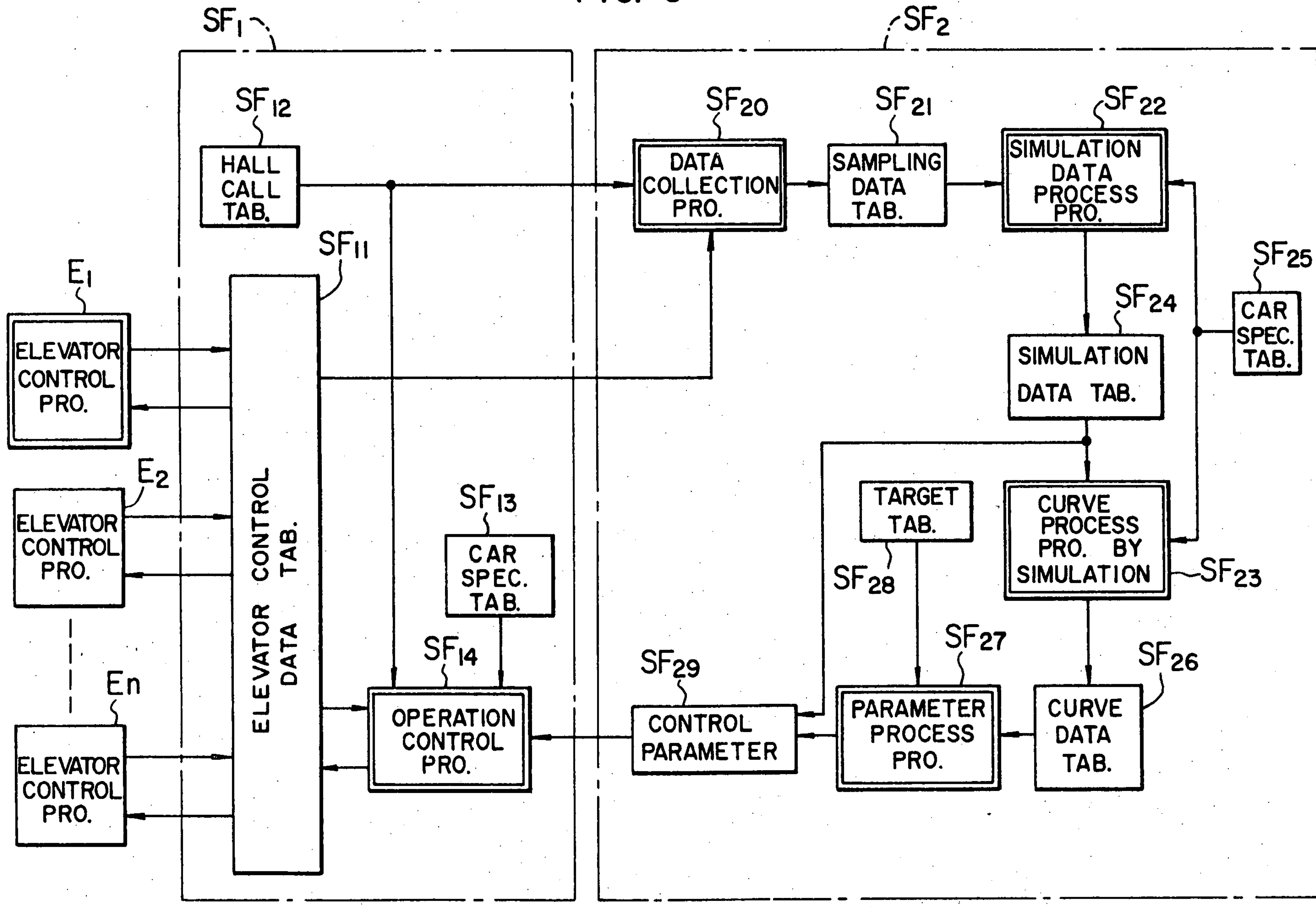

FLOOR
WEIGHTING FACTOR β
STOP PROBA-BILITY S
B X S
CCi+2
i+2
5
1.0
5.0
i+1
10
0
0
HCi
i
CCi
20
1.0
20.0
HCi-1
i-1
10
1.0
10.0
i-2
5
0
0
E

FIG. 6



SF1
SF2
SF12
HALL CALL TAB.
SF11
ELEVATOR CONTROL DATA TAB.
SF13
CAR SPEC. TAB.
SF14
OPERATION CONTROL PRO.
SF20
DATA COLLECTION PRO.
SF21
SAMPLING DATA TAB.
SF22
SIMULATION DATA PROCESS PRO.
SF25
CAR SPEC. TAB.
SF24
SIMULATION DATA TAB.
SF23
CURVE PROCESS PRO. BY SIMULATION
TARGET TAB.
SF28
SF27
PARAMETER PROCESS PRO.
SF26
CURVE DATA TAB.
SF29
CONTROL PARAMETER
E1
ELEVATOR CONTROL PRO.
E2
ELEVATOR CONTROL PRO.
En
ELEVATOR CONTROL PRO.

FIG. 8

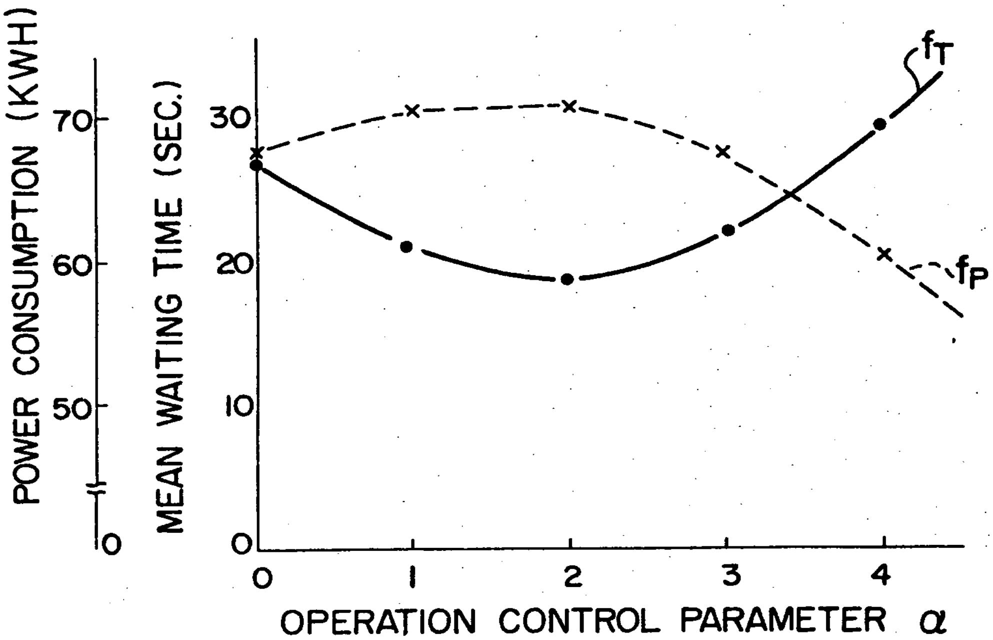

POWER CONSUMPTION (KWH)
70
60
50
0
MEAN WAITING TIME (SEC.)
30
20
10
0
0
1
2
3
4
OPERATION CONTROL PARAMETER α
f_T
f_P

FIG. 9

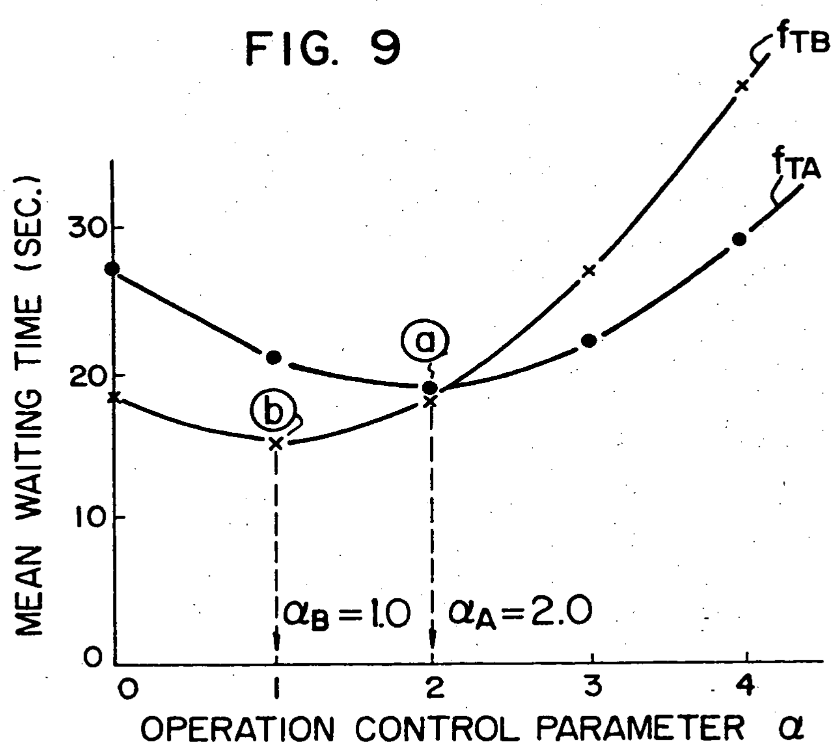

MEAN WAITING TIME (SEC.)
30
20
10
0
0
1
2
3
4
OPERATION CONTROL PARAMETER α
f_{TB}
f_{TA}
a
b
$\alpha_B = 1.0$
$\alpha_A = 2.0$

FIG. 10

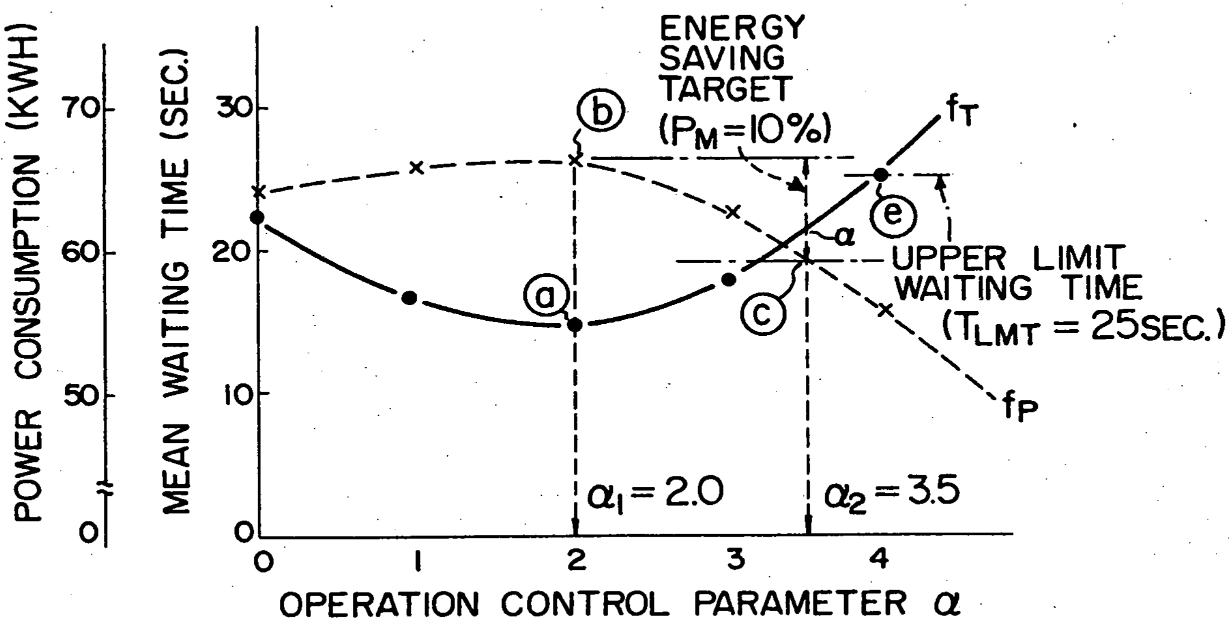

ENERGY SAVING TARGET (P_M=10%)
f_T
f_P
b
a
c
e
α
UPPER LIMIT WAITING TIME (T_{LMT} = 25SEC.)
POWER CONSUMPTION (KWH)
MEAN WAITING TIME (SEC.)
70
60
50
0
30
20
10
0
α_1 = 2.0
α_2 = 3.5
0
1
2
3
4
OPERATION CONTROL PARAMETER α

FIG. 11

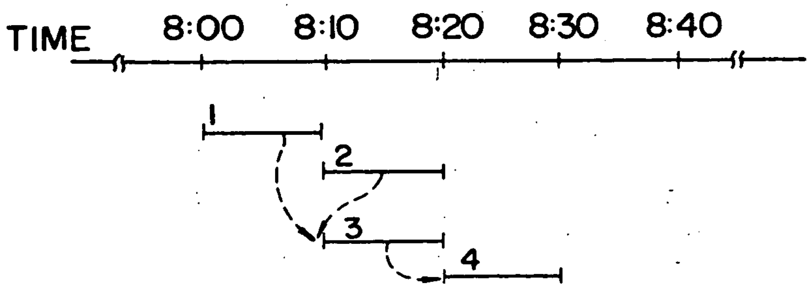

TIME
8:00
8:10
8:20
8:30
8:40
1
2
3
4

FIG. 12

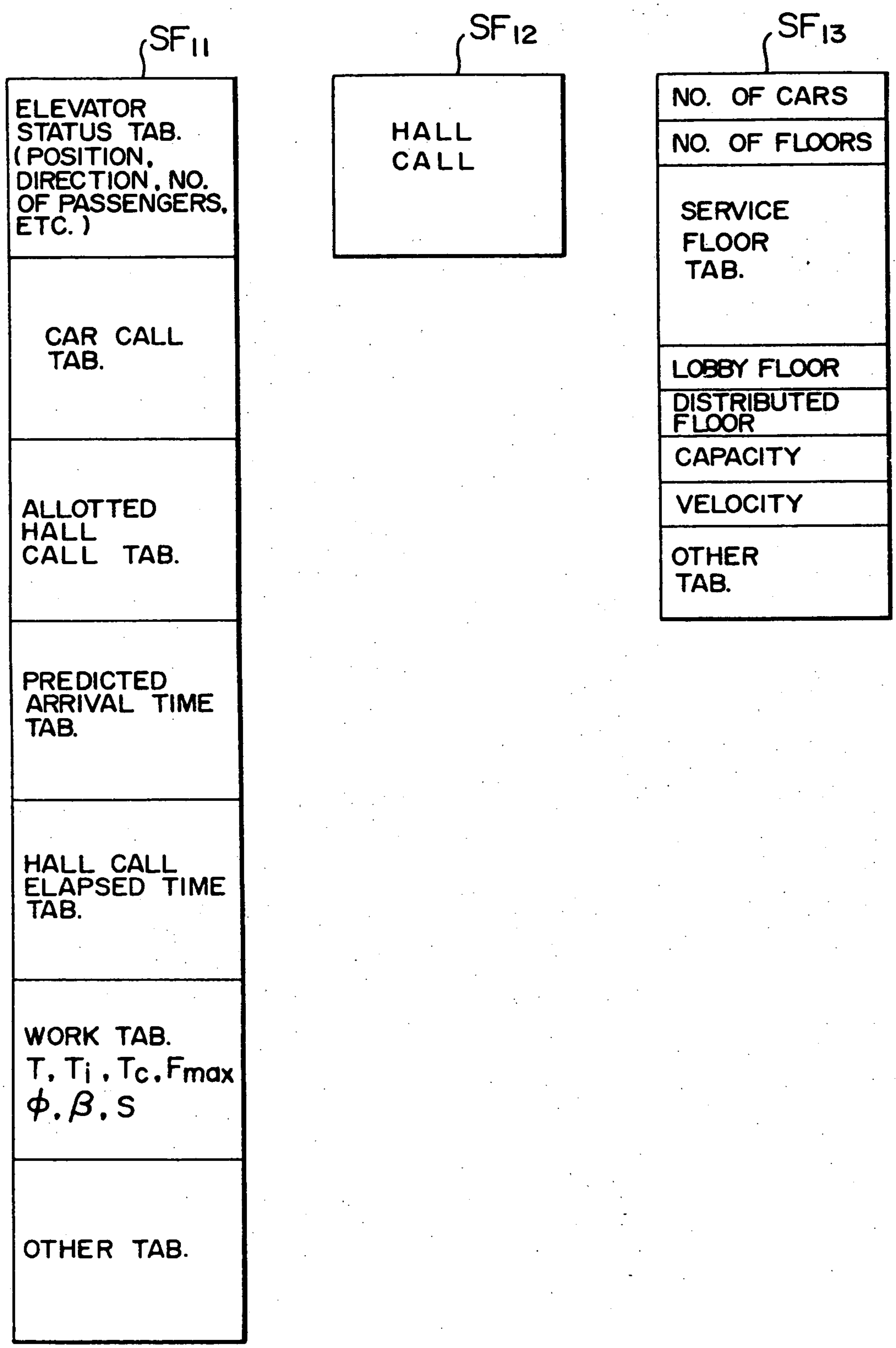

SF11
ELEVATOR STATUS TAB. (POSITION, DIRECTION, NO. OF PASSENGERS, ETC.)
CAR CALL TAB.
ALLOTTED HALL CALL TAB.
PREDICTED ARRIVAL TIME TAB.
HALL CALL ELAPSED TIME TAB.
WORK TAB. T, T_i, T_c, F_{max} ϕ, β, S
OTHER TAB.
SF12
HALL CALL
SF13
NO. OF CARS
NO. OF FLOORS
SERVICE FLOOR TAB.
LOBBY FLOOR
DISTRIBUTED FLOOR
CAPACITY
VELOCITY
OTHER TAB.

FIG. 13

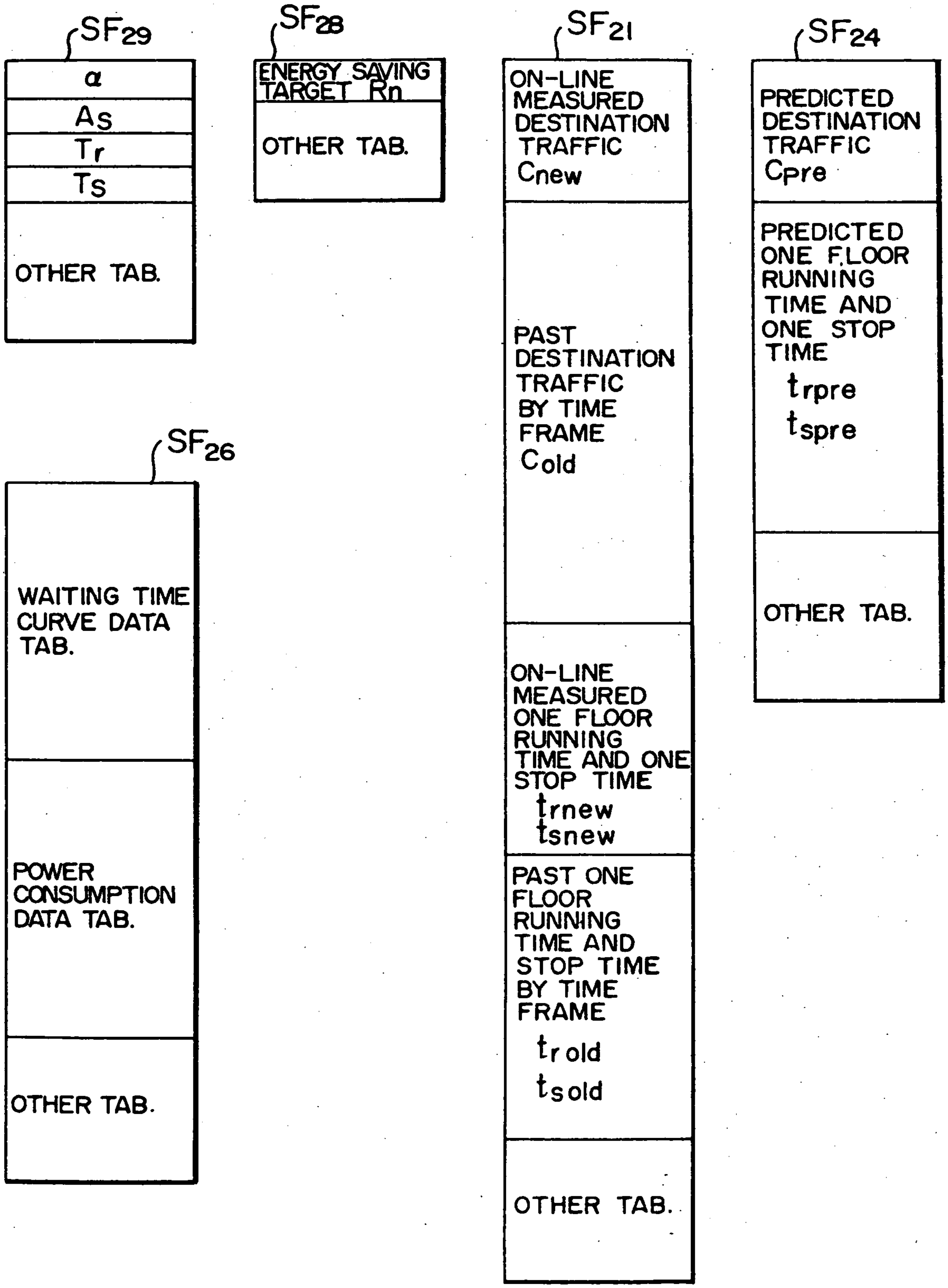

SF29
α
As
Tr
Ts
OTHER TAB.
SF28
ENERGY SAVING TARGET Rn
OTHER TAB.
SF21
ON-LINE MEASURED DESTINATION TRAFFIC Cnew
PAST DESTINATION TRAFFIC BY TIME FRAME Cold
ON-LINE MEASURED ONE FLOOR RUNNING TIME AND ONE STOP TIME
trnew
tsnew
PAST ONE FLOOR RUNNING TIME AND STOP TIME BY TIME FRAME
trold
tsold
OTHER TAB.
SF24
PREDICTED DESTINATION TRAFFIC Cpre
PREDICTED ONE FLOOR RUNNING TIME AND ONE STOP TIME
trpre
tspre
OTHER TAB.
SF26
WAITING TIME CURVE DATA TAB.
POWER CONSUMPTION DATA TAB.
OTHER TAB.

FIG. 14

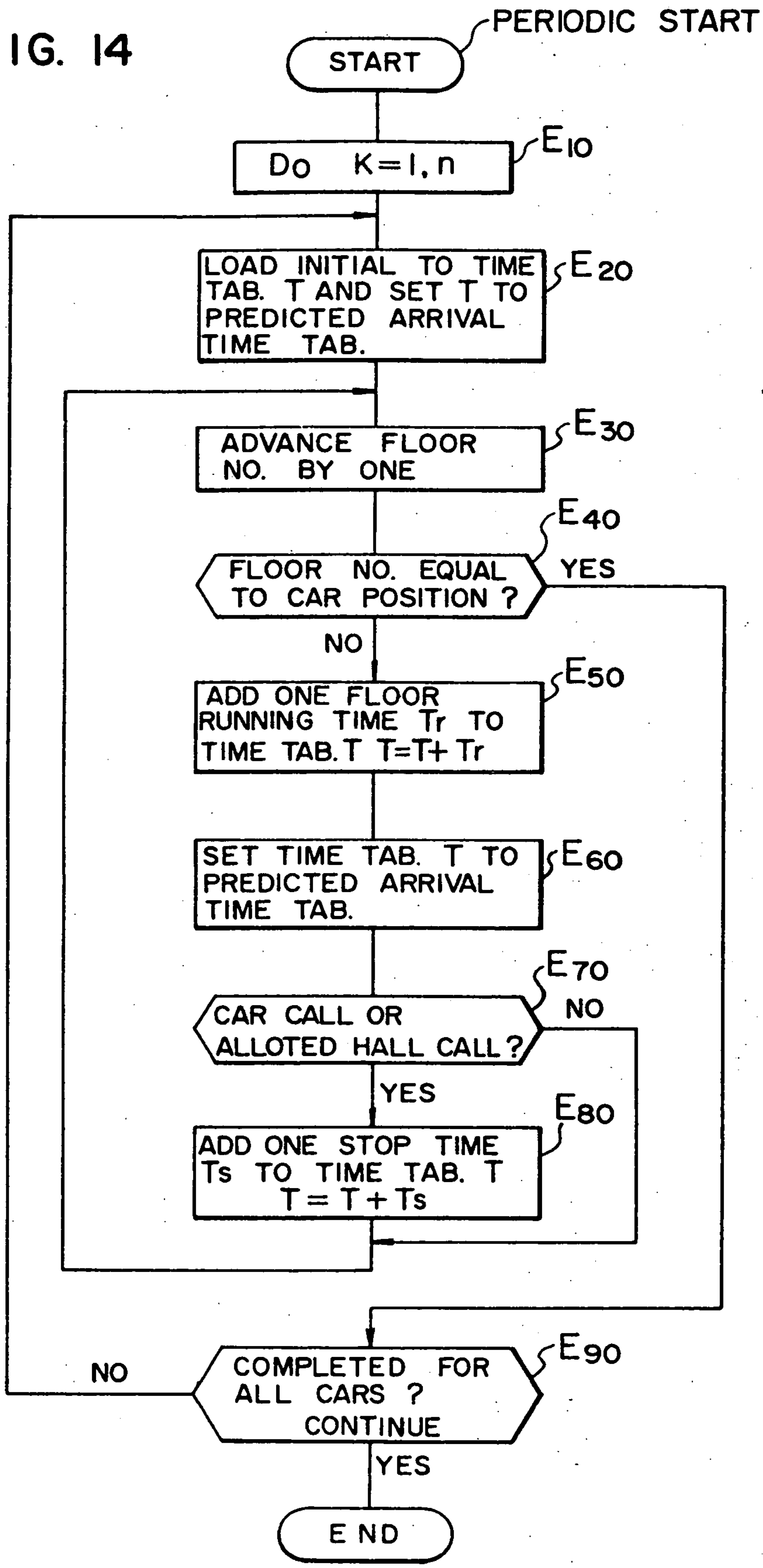

PERIODIC START
START
E10
Do K=1, n
E20
LOAD INITIAL TO TIME TAB. T AND SET T TO PREDICTED ARRIVAL TIME TAB.
E30
ADVANCE FLOOR NO. BY ONE
E40
FLOOR NO. EQUAL TO CAR POSITION ?
YES
NO
E50
ADD ONE FLOOR RUNNING TIME Tr TO TIME TAB. T T=T+Tr
E60
SET TIME TAB. T TO PREDICTED ARRIVAL TIME TAB.
E70
CAR CALL OR ALLOTED HALL CALL ?
NO
YES
E80
ADD ONE STOP TIME Ts TO TIME TAB. T T=T+Ts
E90
NO
COMPLETED FOR ALL CARS ? CONTINUE
YES
END

FIG. 15

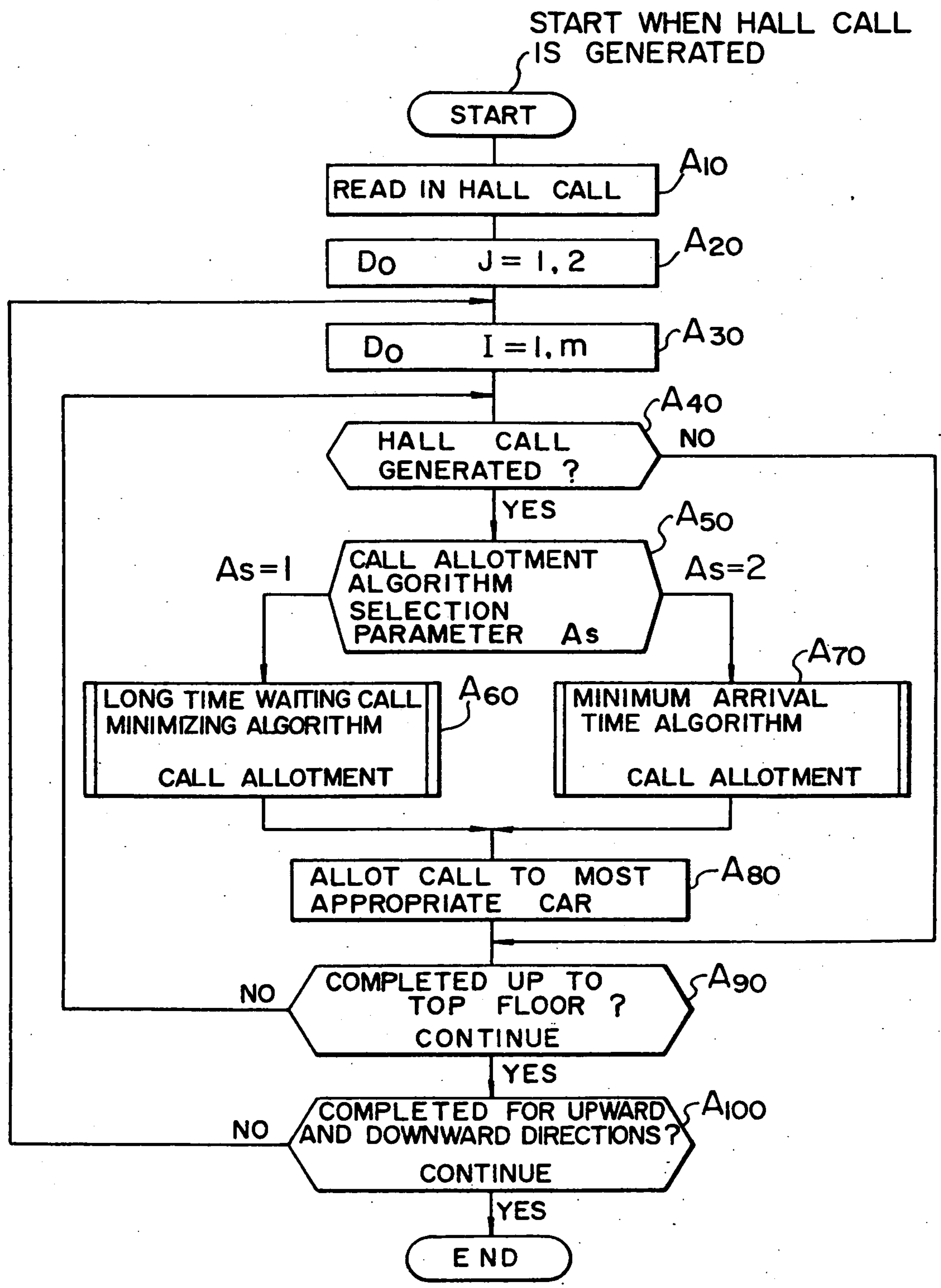

START WHEN HALL CALL IS GENERATED
START
READ IN HALL CALL
A10
Do J = 1, 2
A20
Do I = 1, m
A30
A40
HALL CALL GENERATED ?
NO
YES
A50
CALL ALLOTMENT ALGORITHM SELECTION PARAMETER As
As=1
As=2
A70
LONG TIME WAITING CALL MINIMIZING ALGORITHM CALL ALLOTMENT
A60
MINIMUM ARRIVAL TIME ALGORITHM CALL ALLOTMENT
ALLOT CALL TO MOST APPROPRIATE CAR
A80
NO
COMPLETED UP TO TOP FLOOR ? CONTINUE
A90
YES
NO
COMPLETED FOR UPWARD AND DOWNWARD DIRECTIONS? CONTINUE
A100
YES
END

FIG. 16

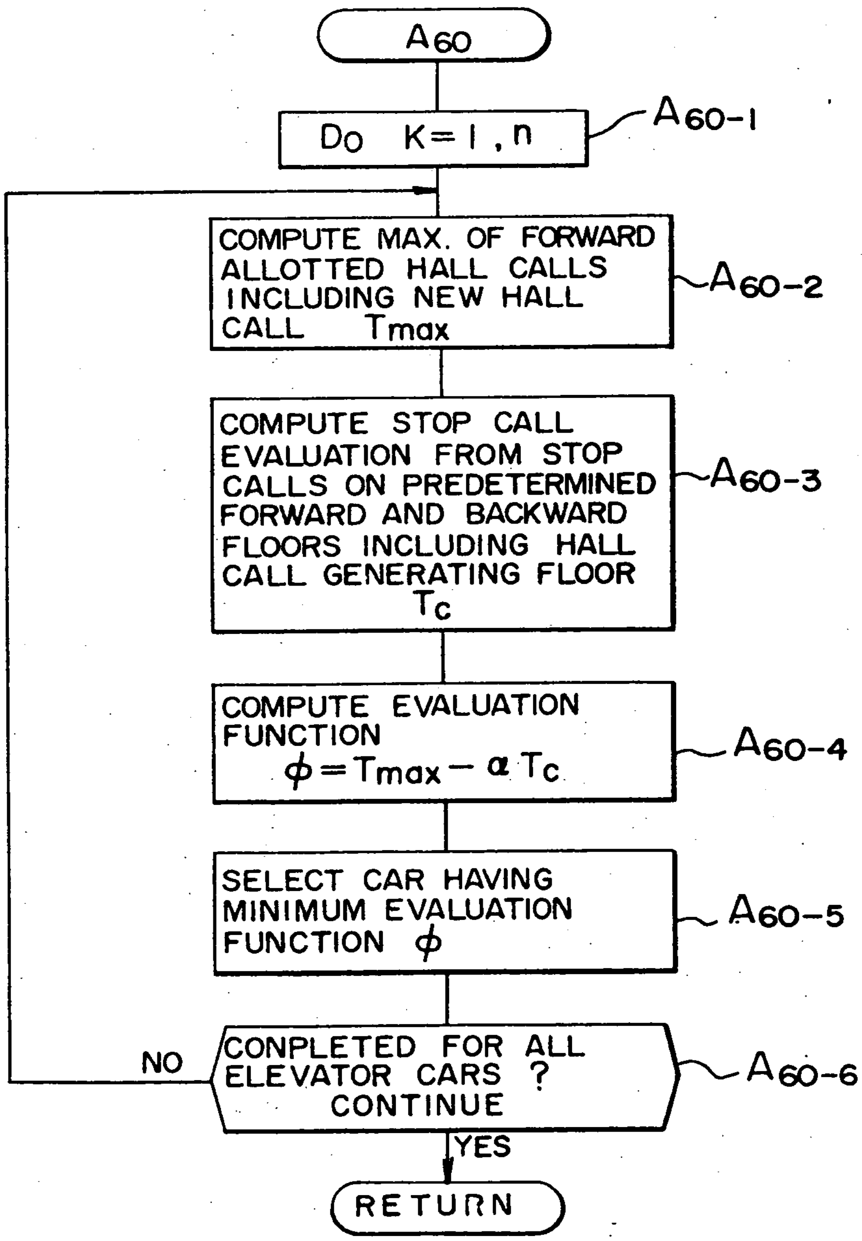

A60
Do K=1, n
A60-1
COMPUTE MAX. OF FORWARD ALLOTTED HALL CALLS INCLUDING NEW HALL CALL Tmax
A60-2
COMPUTE STOP CALL EVALUATION FROM STOP CALLS ON PREDETERMINED FORWARD AND BACKWARD FLOORS INCLUDING HALL CALL GENERATING FLOOR Tc
A60-3
COMPUTE EVALUATION FUNCTION φ=Tmax − α Tc
A60-4
SELECT CAR HAVING MINIMUM EVALUATION FUNCTION φ
A60-5
CONPLETED FOR ALL ELEVATOR CARS ? CONTINUE
A60-6
NO
YES
RETURN

FIG. 17

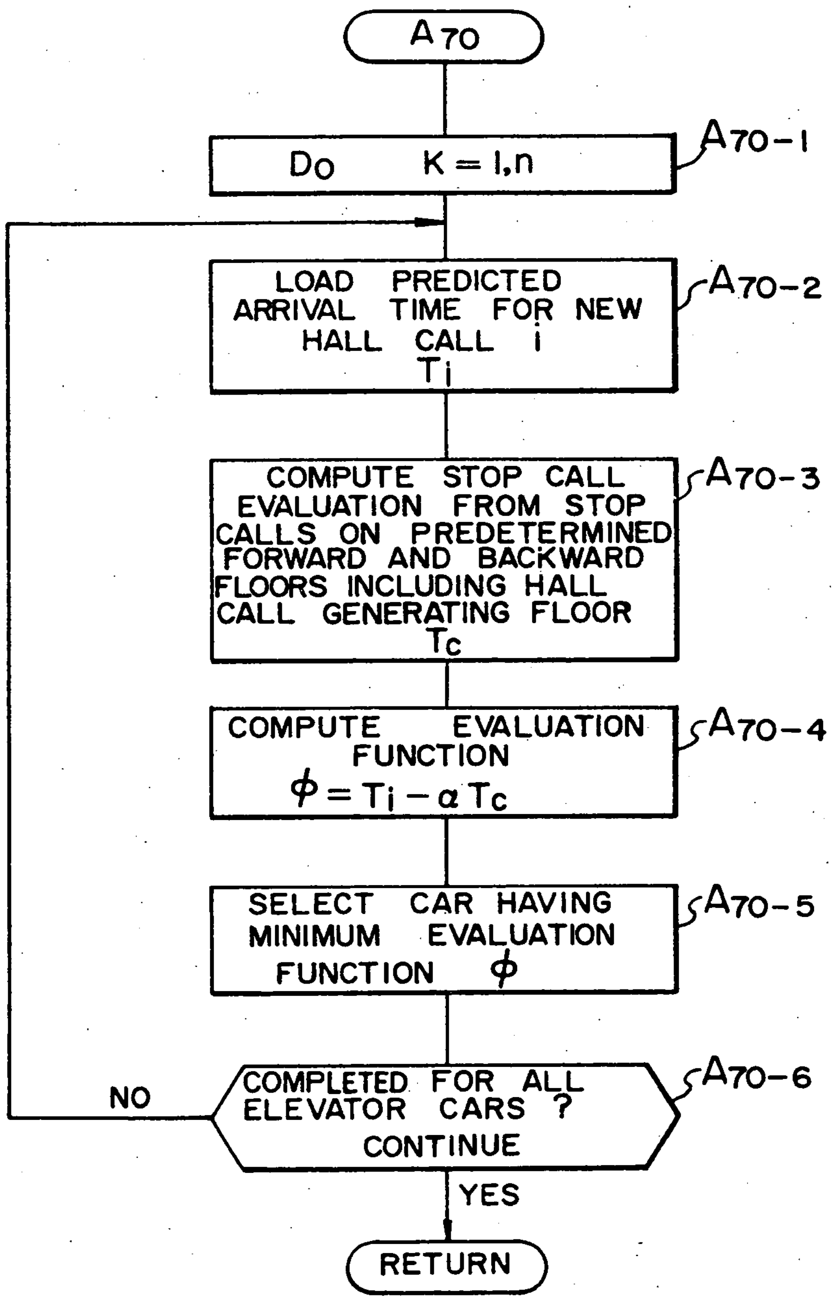

A70
Do K = 1,n
A70-1
LOAD PREDICTED ARRIVAL TIME FOR NEW HALL CALL i
Ti
A70-2
COMPUTE STOP CALL EVALUATION FROM STOP CALLS ON PREDETERMINED FORWARD AND BACKWARD FLOORS INCLUDING HALL CALL GENERATING FLOOR
Tc
A70-3
COMPUTE EVALUATION FUNCTION
φ = Ti − αTc
A70-4
SELECT CAR HAVING MINIMUM EVALUATION FUNCTION φ
A70-5
COMPLETED FOR ALL ELEVATOR CARS ?
CONTINUE
A70-6
NO
YES
RETURN

FIG. 18

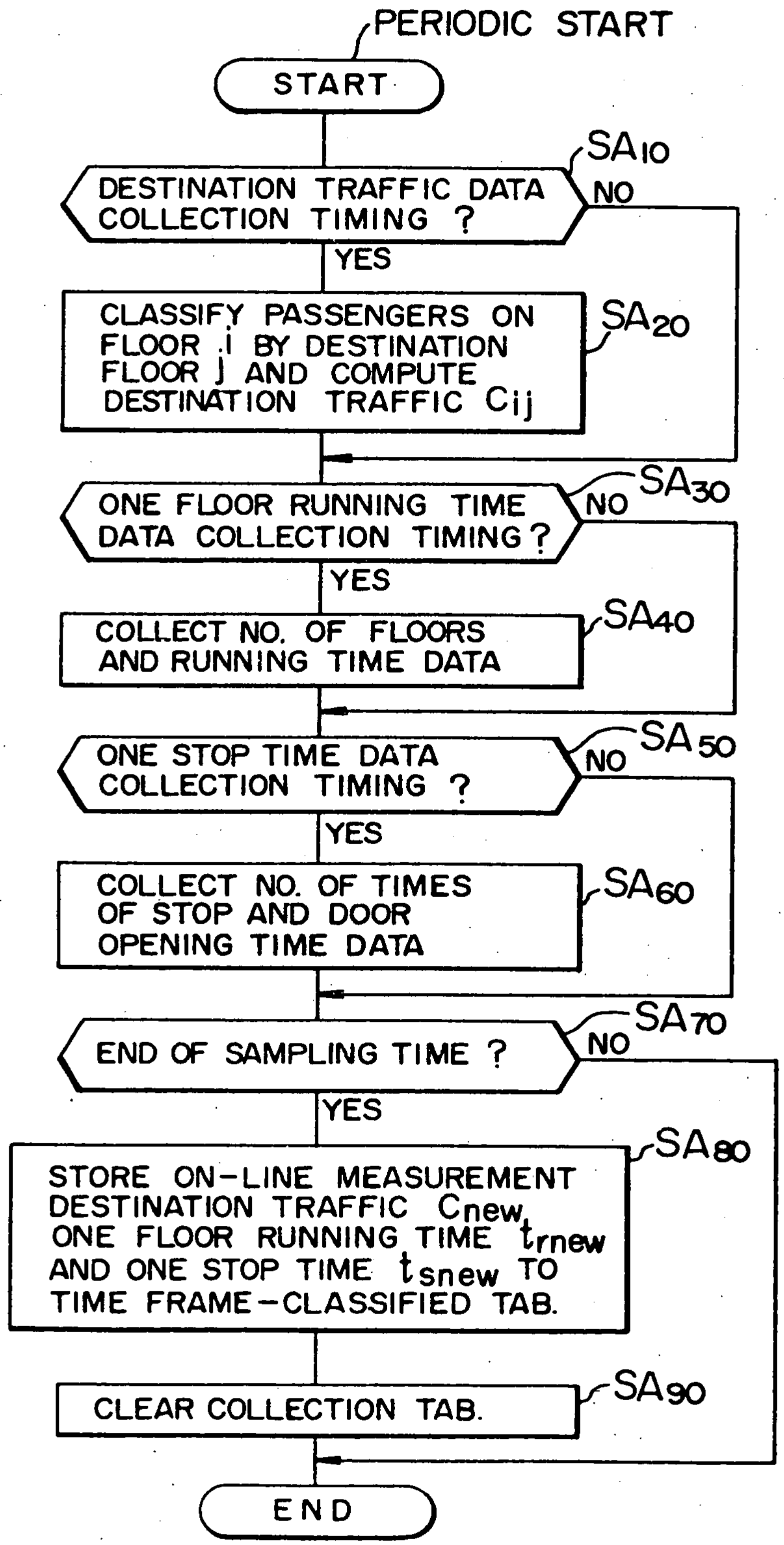

PERIODIC START
START
SA10
DESTINATION TRAFFIC DATA COLLECTION TIMING ?
NO
YES
CLASSIFY PASSENGERS ON FLOOR i BY DESTINATION FLOOR j AND COMPUTE DESTINATION TRAFFIC Cij
SA20
SA30
ONE FLOOR RUNNING TIME DATA COLLECTION TIMING?
NO
YES
COLLECT NO. OF FLOORS AND RUNNING TIME DATA
SA40
SA50
ONE STOP TIME DATA COLLECTION TIMING ?
NO
YES
COLLECT NO. OF TIMES OF STOP AND DOOR OPENING TIME DATA
SA60
SA70
END OF SAMPLING TIME ?
NO
YES
STORE ON-LINE MEASUREMENT DESTINATION TRAFFIC Cnew, ONE FLOOR RUNNING TIME trnew AND ONE STOP TIME tsnew TO TIME FRAME-CLASSIFIED TAB.
SA80
CLEAR COLLECTION TAB.
SA90
END

FIG. 19

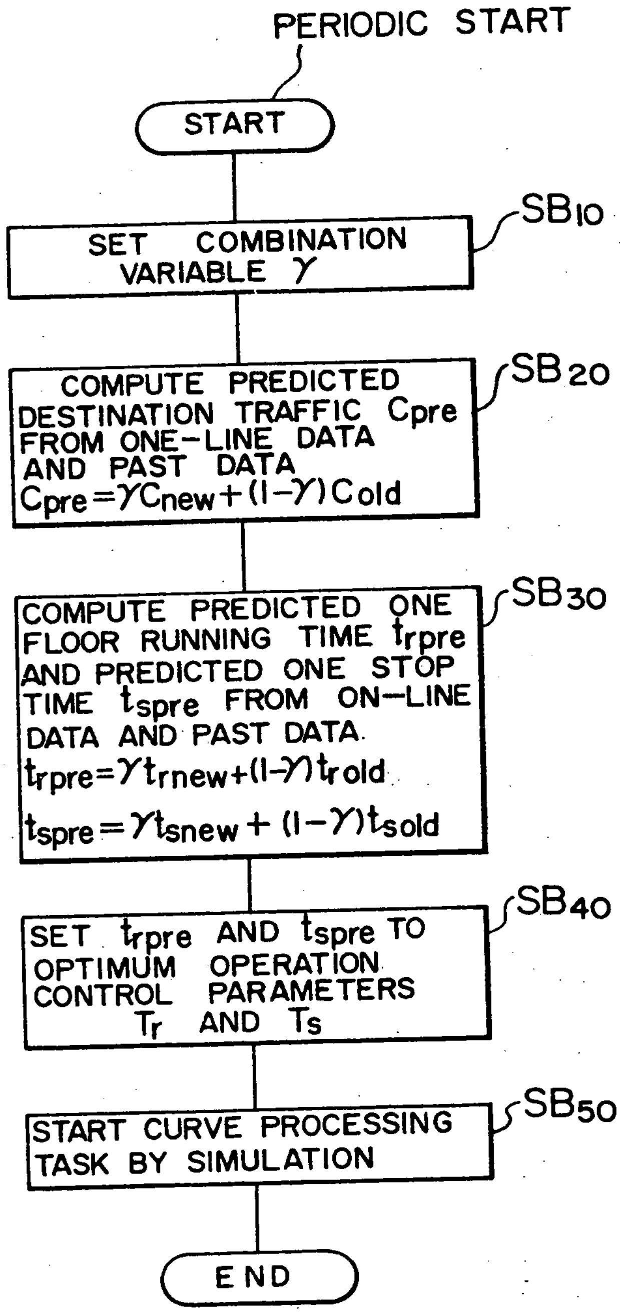

PERIODIC START
START
SET COMBINATION VARIABLE γ
SB10
COMPUTE PREDICTED DESTINATION TRAFFIC Cpre FROM ONE-LINE DATA AND PAST DATA
$C_{pre} = \gamma C_{new} + (1-\gamma) C_{old}$
SB20
COMPUTE PREDICTED ONE FLOOR RUNNING TIME t_{rpre} AND PREDICTED ONE STOP TIME t_{spre} FROM ON-LINE DATA AND PAST DATA.
$t_{rpre} = \gamma t_{rnew} + (1-\gamma) t_{rold}$
$t_{spre} = \gamma t_{snew} + (1-\gamma) t_{sold}$
SB30
SET t_{rpre} AND t_{spre} TO OPTIMUM OPERATION CONTROL PARAMETERS T_r AND T_s
SB40
START CURVE PROCESSING TASK BY SIMULATION
SB50
END

FIG. 20

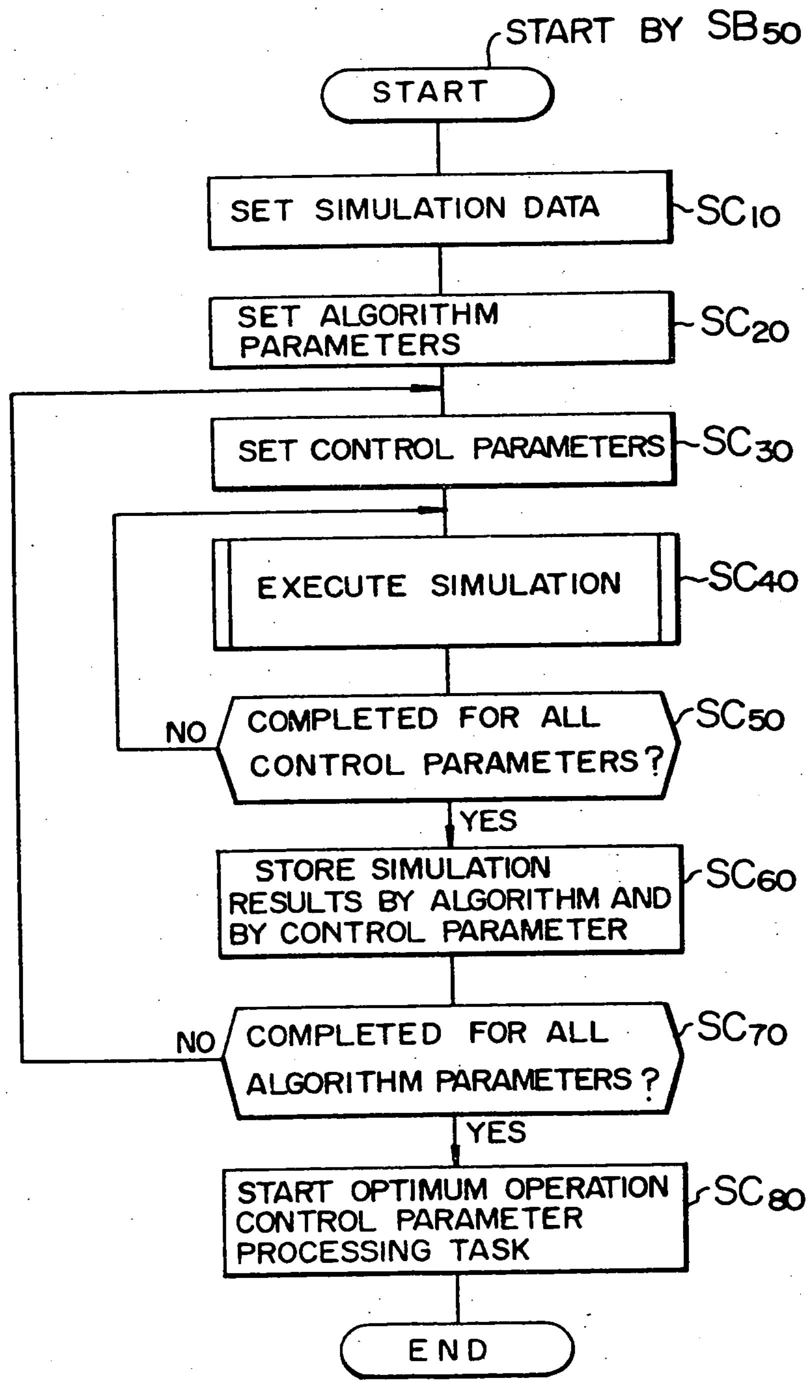

START BY SB_{50}
START
SET SIMULATION DATA
SC_{10}
SET ALGORITHM PARAMETERS
SC_{20}
SET CONTROL PARAMETERS
SC_{30}
EXECUTE SIMULATION
SC_{40}
NO
COMPLETED FOR ALL CONTROL PARAMETERS?
SC_{50}
YES
STORE SIMULATION RESULTS BY ALGORITHM AND BY CONTROL PARAMETER
SC_{60}
NO
COMPLETED FOR ALL ALGORITHM PARAMETERS?
SC_{70}
YES
START OPTIMUM OPERATION CONTROL PARAMETER PROCESSING TASK
SC_{80}
END

FIG. 21

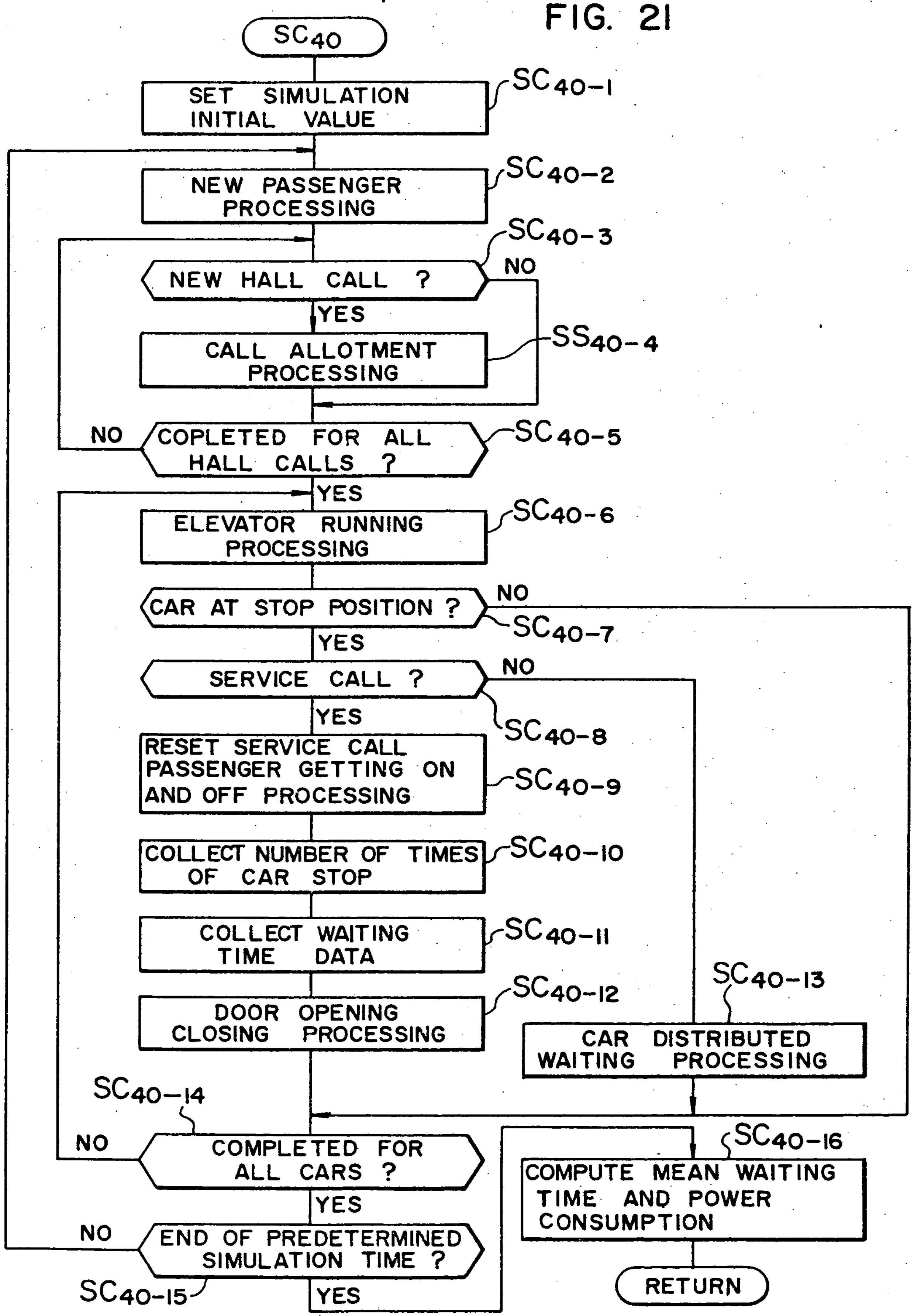
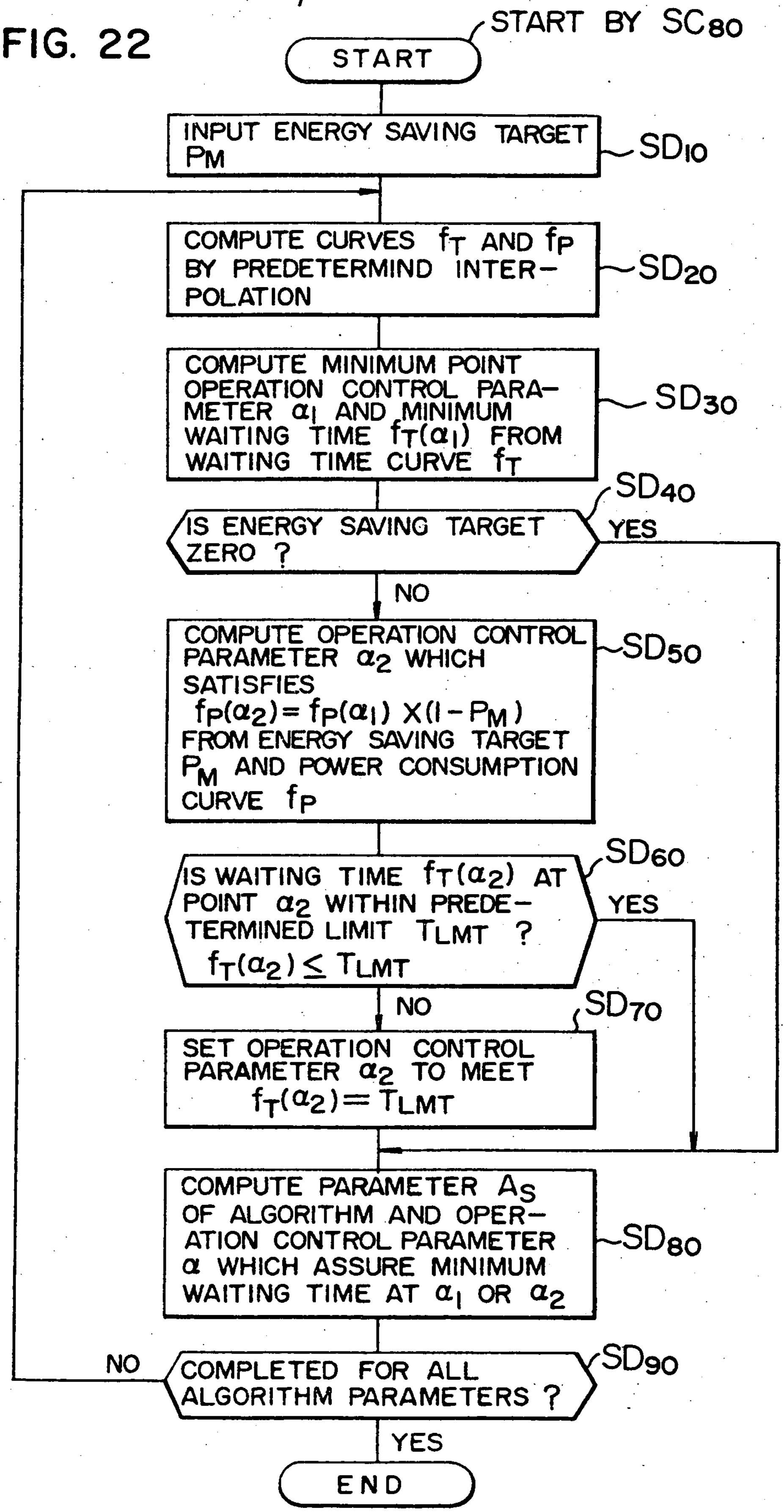

SC40
SET SIMULATION INITIAL VALUE
SC40-1
NEW PASSENGER PROCESSING
SC40-2
NEW HALL CALL ?
SC40-3
NO
YES
CALL ALLOTMENT PROCESSING
SS40-4
COPLETED FOR ALL HALL CALLS ?
SC40-5
NO
YES
ELEVATOR RUNNING PROCESSING
SC40-6
CAR AT STOP POSITION ?
NO
SC40-7
YES
SERVICE CALL ?
NO
YES
SC40-8
RESET SERVICE CALL PASSENGER GETTING ON AND OFF PROCESSING
SC40-9
COLLECT NUMBER OF TIMES OF CAR STOP
SC40-10
COLLECT WAITING TIME DATA
SC40-11
DOOR OPENING CLOSING PROCESSING
SC40-12
SC40-13
CAR DISTRIBUTED WAITING PROCESSING
SC40-14
NO
COMPLETED FOR ALL CARS ?
YES
SC40-16
COMPUTE MEAN WAITING TIME AND POWER CONSUMPTION
NO
END OF PREDETERMINED SIMULATION TIME ?
SC40-15
YES
RETURN

FIG. 22


START BY SC_{80}
START
INPUT ENERGY SAVING TARGET P_M
SD_{10}
COMPUTE CURVES f_T AND f_P BY PREDETERMIND INTER-POLATION
SD_{20}
COMPUTE MINIMUM POINT OPERATION CONTROL PARA-METER α_1 AND MINIMUM WAITING TIME $f_T(\alpha_1)$ FROM WAITING TIME CURVE f_T
SD_{30}
IS ENERGY SAVING TARGET ZERO ?
SD_{40}
YES
NO
COMPUTE OPERATION CONTROL PARAMETER α_2 WHICH SATISFIES $f_P(\alpha_2) = f_P(\alpha_1) \times (1 - P_M)$ FROM ENERGY SAVING TARGET P_M AND POWER CONSUMPTION CURVE f_P
SD_{50}
IS WAITING TIME $f_T(\alpha_2)$ AT POINT α_2 WITHIN PREDE-TERMINED LIMIT T_{LMT} ? $f_T(\alpha_2) \leq T_{LMT}$
SD_{60}
YES
NO
SET OPERATION CONTROL PARAMETER α_2 TO MEET $f_T(\alpha_2) = T_{LMT}$
SD_{70}
COMPUTE PARAMETER A_S OF ALGORITHM AND OPER-ATION CONTROL PARAMETER α WHICH ASSURE MINIMUM WAITING TIME AT α_1 OR α_2
SD_{80}
NO
COMPLETED FOR ALL ALGORITHM PARAMETERS ?
SD_{90}
YES
END

SPECIFICATION

Control system for group-controlling elevator cars

The present invention relates to a control system for group controlling elevator cars, and more particularly to a system suitable to group-control elevator cars by utilizing a computer.

A microcomputer has been recently used in various industrial fields and it is also used in a field of elevator in a control system for group-controlling elevator cars which effectively controls a plurality of elevator cars and a control system which controls individual elevator cars. Such an attempt has been made a great contribution to the elevator control system because of features of small size, high performance, high reliability and low cost, which are inherent to the microcomputer.

For example, in the group control system respective hall calls are monitored on an on-line basis and the most suitable elevator car is selected and allotted for service while taking service to overall hall calls into consideration so that a waiting time is substantially reduced. Also, a prioritized service control for allotting a plurality of elevator cars to a hall of many passengers or allotting a short waiting time elevator car to an executive hall is possible so that a delicate control is attained.

On the other hand, in an elevator monitoring system, U.S. Patent 3,973,648 teaches an advanced form of computer utilization. It connects a system processor which controls the group-control of the elevator cars and a processor at a control monitoring site through a telephone line to attain efficient monitoring. In this system, in night time in which the elevator system need not be operated, the system processor is disconnected from the elevator system and connected to a processor at the central monitoring site having a simulation function so that the performance and operation status of the system processor are compared with simulated results to efficiently monitor the operation.

Thus, by utilizing the computer such as the microcomputer, the performance and function are greatly enhanced to compare with a random logic configuration.

However, the operation of the prior art control system for group-controlling the elevator cars is controlled by predetermined fixed control functions and parameters. Accordingly, it is not always suitable to a building environment which varies from time to time. For example, destination traffic demand when a building was built differs from that after tenants have changed or business has changed. Within a day, the destination traffic demands at business starting time, lunch time, business ending time and normal time differ substantially.

As the traffic demands change substantially, an efficient control is difficult to attain, resulting in reduction of servicability.

When the traffic demands in a building is not known such as when the elevator system is installed , it is difficult to control the elevator cars to comply with the traffic demands.

It is an object of the present invention to provide a control system for group-controlling elevator cars which is adaptable to a change of traffic demand and provides an elevator service at a high efficiency.

In accordance with a principal feature of the present invention, an operation of a plurality of elevators is controlled in accordance with a predetermined evaluation function having a variable parameter. Means for simulating the controlled operation is provided to simulate the controlled operation of a plurality of elevator cars in order to determine a variable parameter suitable to an actual operation and carry out the controlled operation in accordance with the determined parameter.

Besides the above object and feature, in accordance with the present invention, an evaluation function for selecting an elevator car which serves to a hall call is used, and a waiting time as well as a power consumption are considered as factors of the evaluation function and a relation between those factors is varied in accordance with the simulated result so that an efficient service is attained from both waiting time and power consumption aspects. Those will be described in detail in the embodiment of the present invention.

The drawings show an embodiment of a control system for group-controlling elevator cars in which:

Fig. 1 shows an overall configuration of the control system for group-controlling the elevator cars,
Fig. 2 shows a configuration of a group-control operation system,
Fig. 3 shows a configuration of a simulator system,
Fig. 4 shows a configuration of a control system,
Fig. 5 shows a block diagram of an SDA,
Fig. 6 shows an overall configuration of a software,
Fig. 7 illustrates an evaluation function,
Figs. 8 to 10 show relations between parameters and a waiting time and a power consumption,
Fig. 11 shows a time chart of an operation timing,
Fig. 12 shows a table configuration of a group-controlled operation control system,
Fig. 13 shows a table configuration of a simulation system,
Fig. 14 shows a flow chart for determining a predicted arrival waiting time table,
Fig. 15 shows a flow chart for allotting a call,
Fig. 16 shows a flow chart for determining a minimum waiting time allocation,
Fig. 17 shows a flow chart for determining a minimum predicted arrival wait time allocation,

Fig. 18 shows a flow chart for collecting data,
Fig. 19 shows a flow chart for determining simulation data,
Fig. 20 shows a flow chart for generating curves by simulation,
Fig. 21 shows a flow chart for carrying out the simulation, and
Fig. 22 shows a flow chart for determining an optimum operation control parameter.

One embodiment of the present invention is now explained with reference to Figs. 1—23. A hardware configuration is first explained, then an overall software configuration and control concept thereof are explained, and finally softwares for realizing the control concept is explained with reference to table configurations and flow charts.

In the present embodiment, an evaluation function for selecting an elevator car for a hall call is used. A variable parameter of the evaluation function is called an operation control parameter, and a waiting time and a power consumption are primarily explained as factors of the evaluation function although the present invention is not limited thereto.

Fig. 1 shows an overall hardware configuration of one embodiment of the present invention.

A control system MA for group-controlling elevator cars has a microcomputer M_1 for controlling operation of the elevator cars and a microcomputer M_2 for effecting a simulation. Data are transmitted between the microcomputers M_1 and M_2 by a serial data adaptor SDAc through a communication line CMc. In the present invention, a section which controls the operation of the elevator cars is called a control operation section which is distinguished from a simulation section, and both sections are collectively called a group control unit. The group control unit of the present invention is different from that of a prior art system in that it has the simulation section. A call signal HC from a hall call device HD is applied to the microcomputer M_1 which controls the operation of the elevator cars, through a peripheral interface adaptor PIA. The microcomputer M_1 is connected to elevator control microcomputers E_1—E_n (where n is the number of elevator cars) which control the individual elevator cars such as opening/closing of a door and acceleration-deceleration of the elevator car, through serial data processors SDA_1—SDA_n and communication lines CM_1—CM_n.

On the other hand, a signal PM from a presetter PD which supplies information necessary to determine an optimum operation control parameter for the simulation is applied to the microcomputer M_2 through a peripheral interface adaptor.

Control input/output devices EIO_1—EIO_n which comprise safety limit switches, relays and lamps and supply car call information necessary for the control are connected to peripheral interface adaptors of the elevator control microcomputers E_1—E_n through signal lines SIO_1—SIO_n.

A general operation of the present invention is now explained with reference to Fig. 1.

The microcomputer M_1 for controlling the operation of the elevator cars contains an operation control program for call allotment and it reads in data necessary for the control from the elevator control microcomputers E_1—E_n and the hall call devices HD. Of those data, the data necessary for the simulation are supplied to the simulation microcomputer M_2 through the serial data adaptor SDAc. The operation control program is processed by utilizing variable operation control parameters. For example, the parameters may include a weighting factor representing a relation between evaluation values of a waiting time and a power consumption in a call allotment evaluation function, a time factor for determining door opening/closing time and a control parameter for selecting a call allotment control logic or a call allotment algorithm.

Those operation control parameters are processed by the simulation microcomputer M_2 by utilizing the instruction PM from the presetter PD and the simulation data. They are periodically processed on a real time basis and optimum operation control parameters for group-controlling the elevator cars are periodically produced.

For example, if the presetter PD instruct a minimum waiting time, a current traffic demand is predicted and a simulation is made based on the predicted data to select a call allotment algorithm and an operation control factor which make the waiting time minimum. Those are used as the optimum operation control parameters in the current traffic demand condition. Accordingly, in the present invention, the group control of the elevator cars is adaptable to the building environment which changes from time to time and hence the performance of the group control of the elevator cars is greatly improved.

Specific hardware configurations of the microcomputers are shown in Figs. 2—4. Microprocessing units (MPU) which are hearts of the microcomputers are 8-bit or 16-bit units. The elevator control microcomputers E_1—E_n may use the 8-bit MPU's because of relatively low processing capability required while the elevator operation control microcomputer M_1 and the simulation microcomputer M_2 preferably use the higher performance 16-bit MPU's because they have to process complex operations. The 8-bit MPU may be Hitachi HD46800D, Intel 28085 or Zeilog Z-80, and the 16-bit MPU may be Hitachi HD680000, Intel I8086 or Zeilog Z-8000.

As shown in Figs. 2—4, connected to each of the microcomputers are a read-only memory (ROM) which contains a control program and an elevator car specification, a random access memory (RAM) which contains control data and work data, a peripheral interface adapter (PIA) and serial data adapters (SDA) (for example, Hitachi HD43370) for serially communicating with other microcomputers, through a bus line (BUS) of the PUM.

The RAM's and the ROM's of the microcomputers M_1, M_2 and E_1—E_n may be constructed by a plurality of units depending on the sizes of the control programs.

In Fig. 3, the presetter PD comprises a presetting potentiometer VR and A/D converter for converting an analog output voltage of the potentiometer VR to a digital signal, and an output PM of the A/D converter is read into the RAM through the PIA.

In Fig. 4, data from a car call button CB, a safety limit switch SW_L and a relay contact SW_{RY}, and a car weight Wight are read into the RAM through the PIA. On the other hand, the data processed by the MPU are supplied to the control output devices such as a lamp and a relay R_Y.

A hardware configuration of the serial data adaptor SDA for serially communicating between the microcomputers used in Figs. 2—4 is shown in Fig. 5. It comprises a transmitting buffer TX_B, a receiving buffer RX_B, a serializer P/S for converting parallel data to serial data, a deserializer S/P for converting serial data to parallel data and a controller CNT for controlling a timing of those units. The transmitting buffer TX_B and the receiving buffer RX_B are freely accessable by the microcomputer so that data are read and written. The SDA has a function to automatically transmit the content of the transmitting buffer TX_B to the receiving buffer RX_B of the other SDA through the serializer P/S. Accordingly, the microcomputer need not carry out the transmitting and receiving functions and can exclusively carry out other functions. Detailed construction and operation of the SDA are well known, for example, by Japanese Laid-Open Patent Applications 56—37972 and 56—37973.

A software configuration in accordance with one embodiment of the present invention is now explained. First, an overall software configuration is explained with reference to Fig. 6.

As shown in Fig. 6, a software mainly comprises an operating control software SF1 and a simulation software SF2. The former is executed by the microcomputer M1 of Fig. 1 and the latter is excuted by the microcomputer M2.

The operation control software SF1 includes an operation control program SF14 which directly instructs and controls a hall call allotment and group control of the elevator cars such as distributed waiting of the elevator cars. Input information to the operation control program SF14 includes an elevator control data table SF11 such as a position and a direction of an elevator car and a car call transmitted from an elevator control program (contained in each of the microcomputers E_1—E_n of Fig. 1), a hall call table SF12, an elevator car specification table SF13 such as the number of elevator cars to be controlled, and optimum operation control parameters processed by the simulation software SF2.

On the other hand, the simulation software SF2 comprises the following processing programs.

(1) Data collection program SF20 . . . It periodically samples hall calls and the content of the elevator control data table on an on-line basis to collect simulation data. It particularly collects a traffic demand for each destination floor of the elevator car (hereinafter referred to as a destination traffic).

(2) Simulation data processing program SF22 . . . It processes the simulation data while taking into consideration of the content of the on-line sampling data table SF21 collected by the data collection program and the content of the above table in a past time frame.

(3) Curve processing program by simulation SF23 . . . It reads in a simulation data table SF24 and an elevator car specification table SF25 and carries out the simulation for every predetermined number of parameters to produce curve data tables SF26, which may include a waiting time curve table and a power consumption power table.

(4) Optimum operation control parameter processing program SF27 . . . It reads in the curve tables SF26 and a target table SF28 preset by the presetter PD to produce optimum operation control parameters SF29 adapted to a building environment.

A portion of the simulation data table SF24 processed by the simulation data processing program is added to the optimum operation control parameters SF29. This is a kind of learning function because a result of an actual operation is evaluated by the simulation software SF2 and the elevator cars are controlled based on the evaluation result.

The overall software configuration in one embodiment of the present invention has thus been described. Next, the determination of the optimum operation control parameters by the simulation, which is a heart of the present invention, is explained.

In a known method of alloting service to a call, a service (waiting time) to each call is monitored and a hall call is allotted to an elevator car while taking an overall service to the calls into consideration. In this method, the waiting time is used in the call allotment evaluation function. For example, it has been proposed to use a longest waiting time for the already allotted hall calls on the floors ahead of a floor generating a hall call as an evaluation factor, to use a square summation of the waiting times of the already allotted halls on the floors ahead of the floor generating the hall call as the evaluation factor, or to use the waiting time of the newly generated hall call as the evaluation factor. However, since those evaluation factors do not include positional relation among the elevator cars, the elevator cars are operated in a blocked fashion.

British Patent 1,563,321 shows an allotting method which uses a stop call evaluation function as shown in Fig. 7 to prevent the blocked elevator car operation. Briefly, the stop call evaluation function Tc is derived from a waiting time on a floor near a floor generating a new hall call HCi while taking into consideration of the already allotted hall call HCi-1 and the car calls CCi and CCi + 2 of the elevator car E under consideration, and a new evaluation function ϕ is derived based on the evaluation function Tc

and the evaluation value of the waiting time. This is expressed as follows:

$$\phi = T - \alpha Tc \quad (1)$$

$$Tc = \Sigma \beta s \quad (2)$$

where T is the evaluation value of the waiting time, α is a weighting factor α of the waiting time evaluation value T and the stop call evaluation value Tc, β is a weighting factor for example, 0—20 for a stop call (call for service) on an adjacent floor to a floor generating a hall call, and s is a stop probability which is 1.0 when a call to be served is present and an apropriate value ($0 \leq s \leq 1$) when a predicted call is present. In Fig. 7, the predicted call is neglected.

By utilizing the evaluation function (1), the adjacent stop call to the generating hall call is taken into consideration so that the blocked elevator car operation is prevented.

The stop call evaluation value Tc in the example of Fig. 7 is given by the following formula by taking into consideration of two up and down floors of the call generaing floor i.

$$Tc = \Sigma \beta s = 5 \times 1.0 + 10 \times 0 + 20 \times 1.0$$

$$+ 10 \times 1.0 + 5 \times 0 = 35 \text{ (seconds)}$$

Assuming that the waiting time evaluation T is same for each elevator car, the elevator car having a large Tc is determined to be the optimum one and the generated hall call is allotted to that elevator car.

Now, considering the weighting factor α of the waiting time evaluation value T and the stop call valuation value Tc, the weighting factor α has a value which is most effective to prevent the blocked elevator car operation, with which value the waiting time of the entire building (mean waiting time) is minimum.

On the other hand, as the weighting factor α increases, an elevator car having many stop calls is preferentially selected and hence a load is concentrated to specific elevator car and the mean weighting time increases. Conversely, the loads to other elevators are reduced and the number of times of stop (or start) of the elevator cars decreases so that the power consumption decreases.

An example of such a relation is shown in Table 1 and Fig. 8, which illustrate a simulation under a condition of 13 floors of the building, six elevator cars and an elevator car velocity of 150 m/min. Here, the weighting factor α is called the operation control parameter and the simulation is made for five cases, that is, $\alpha = 0, 1, 2, 3$ and 4.

TABLE 1

Evaluation Index / Operation control parameter (α)	Mean waiting time	Power consumption
0	27 sec.	68 KWH
1	21 sec.	71 KWH
2	19 sec.	71 KWH
3	22 sec.	68 KWH
4	29 sec.	60 KWH

As shown in Fig. 8, by changing the operation control parameter α, a mean waiting time curve fT and a power consumption curve f_p are drawn. It is seen from those curves that a minimum point exists in the mean waiting time and that as the parameter α increases, the power consumption decreases and the mean waiting time increases.

The above simulation is resulted under a certain destination traffic. As described above, the destination traffic changes from time to time. For example, the destination traffic pattern in a normal time frame is completely different from that in a business ending time frame. In the normal time frame, a

certain traffic exists both upward and downward, but in the business ending time frame, the downward traffic is substantial. When the tenants of the building change, the destination traffic pattern changes from the previous one. Accordingly, by making the simulation for the destination traffic patterns A and B, mean waiting time curves f_{TA} and f_{TB} shown in Fig. 9 are drawn. It is seen from Fig. 9 that minimum points of the mean waiting time are points (a) and (b) and α_A is 2.0 for the curve f_{TA} and α_B is 1.0 for the curve f_{TB} and hence it is advisable to change the operation control parameter α separately for each destination traffic in order to reduce the mean waiting time.

This also relates to an algorithm of the call allotment evaluation function. That is, the mean waiting time curve changes depending on the waiting time evaluation algorithm of the evaluation formula (1). Accordingly, in order to reduce the mean waiting time, there exist an optimum operation control parameter α and an appropriate evaluation algorithm for a given destination traffic.

Referring to Fig. 10, a concept of an energy saving operation is explained. Let us assume that a mean waiting time curve f_T and a power consumption curve f_P have been derived by the simulation and a target value P_M of energy saving is set to 10%. When the energy saving target value is 0%, the operation control parameter α is usually set to α_1 (= 2.0) at the minimum mean waiting time point (a) and hence the power consumption is given by the point (b). Accordingly, when the energy saving target value is 10%, the power consumption is given by a point (c) on the curve f_P. Thus, the operation control parameter α is given by α_2 (= 3.5). In other words, when the operation control parameter α is set to 3.5, the system is controlled to attain 10% energy saving. In Fig. 10, when the energy saving target is set to a large value, the mean waiting time increases accordingly. Therefore, it is important to limit the target value by an upper limit waiting time T_{LMT} (for example, 25 seconds).

As described above, in the present invention, the curves such as the mean waiting curve and the power consumption curve are drawn by the simulation. Accordingly, when a target value is given, an optimum operation control parameter is readily derived.

Fig. 11 shows an example of processing and control timing from the data collection to the actual control by the optimum operation control parameter. It shows an example of a time period from 8:00—8:40. It is assumed that the processing and the control are carried out at a ten-minute interval. (1) First, a destination traffic in a time frame 8:00—8:10 is on-line measured. (2) The on-line measured data and the destination traffic in the time frame 8:10—8:20 of a past data (destination traffic of the previous day or weekly mean traffic) are read from the memory (RAM). (3) A destination traffic in the time frame 8:10—8:20 is predicted based on those two destination traffics. Based on the predicted destination traffic, a simulation is made for the time frame of 8:10—8:20, (4) An actual operation is carried out based on an optimum operation control parameter derived from the simulation.

In the embodiment of the present invention, the time frame of 8:10—8:20 is selected for the past destination traffic. Alternatively, a time frame of 7:50—8:00 may be selected to predict the destination traffic. In this case, the memory capacity may be small because the data for the time frames of one day need not be stored.

Referring to Figs. 12 and 13, the table configurations used in the embodiment of the present invention are explained. Fig. 12 shows a table configuration of the operation control software and it mainly comprises blocks of the elevator control table SF11 the hall call table SF12 and the elevator car specification table SF13. The tables of the respective blocks will be explained when the operation control program is described.

Fig. 13 shows a table configuration of the simulation software and it comprises blocks of the optimum operation control parameter SF29, the curve data table SF26, the target table SF28, the sampling data table SF21, the simulation data table SF24 and the elevator car specification table SF25 (not shown because it is similar to Fig. 12).

One embodiment of the software of the present invention is now explained.

The operation control program is first explained and then the simulation program is explained. It is assumed that the programs to be described below are divided into a plurality of tasks and controlled by a system program which efficiently controls the programs, that is, by an operating system (OS). Accordingly, the program can be started from a system timer or other program.

Figs. 14—17 show flows of the operation control program. An elevator car predicted arrival time table processing program and a call allotment program, which are particularly important in the operation control program are now explained.

Fig. 14 shows a flow for computing a predicted arrival time of the elevator car to any floor, which is a basic data to compute the waiting time evaluation value. This program is periodically started, for example at every second to compute the predicted arrival time of the elevator car from the current position to any floor, for each floor and each elevator car.

In Fig. 14, steps E10 and E90 indicate loop processing to all elevator cars. In a step E20, an initial value is set for the work time table T and a content thereof is set to the predicted arrival time table of Fig. 12. The initial value may be a time required toi start th elevator car from an opening/closing time of a door or a predetermined time before the start in a rest condition of the elevator car.

Then, the floor number is advanced by one (step E30) and it is checked if the floor number is same as the elevator car position (step E40). If it is equal, it means that the predicted arrival time table for one elevator car has been computed, and the program jumps to a step E90 and the same steps are repeated

for other elevator car. If the decision in the step E40 is NO, one floor running time Tr is added to the table T (step E50). Then, the content of the time table T is set to the predicted arrival time table (step E60). Then, it is checked if a car call or allotted hall call, that is, a call to be served by the elevator car under consideration is present or not, and if it is present, one stop time Ts is added to the time Table (step E80) to stop the elevator car. Then, the program jumps to a step E30 and the above steps are repeated for each of the floors.

The one floor running time Tr and the one stop time Ts in the steps E50 and E80, respectively, are given by the simulation software as the optimum operation control parameters.

Fig. 15 shows a flow of the call allotment program which is started when a hall call is generated. This program has two call allotment algorithms, one being a long time waiting call minimizing call allotment algorithm (to be explained in Fig. 16) shown in a step A60 and the other being a minimum predicted arrival time call allotment algorithm (to be explained in Fig. 17) shown in a step A70. Those algorithms are selected by an algorithm selection parameter As in the optimum operation control parameters SF29 shown in Fig. 13.

Referring back to Fig. 15, a hall call generated in a step A10 is externally read. The following loop processing is carried out in steps A20 and A100 and steps A30 and A90. If the hall call is generated, it is processed by one of the call allotment algorithms to allot the call to a selected most appropriate elevator car (step A80).

Fig. 16 shows a processing flow of the long waiting time call minimizing call allotment algorithm. In order to determine the most appropriate one of the elevator cars, the loop processing is carried out in steps A60—1 and A60—6 by the number of times equal to the number of elevator cars. In the loop, a maximum predicted waiting time T_{max} of the allotted hall calls on the forward floors including the hall call generating floor is computed in a step A60—2. The predicted waiting time is a sum of a hall call elapsed time (see Fig. 12) which represents an elapsed time from the generation of the hall call to the present time and the predicted arrival time (see Fig. 12). In the next step A60—3, the stop call evaluation value Tc is computed based on the stop calls on the predetermined forward and backward floors (including the hall call generating floor) as explained in Fig. 7, and the evaluation function ϕ in the formula (1) is computed based on the evaluation value and the maximum predicted waiting time T_{max} (step A60—4). The elevator car having the minimum evaluation function ϕ is selected (step A60—5). The above steps are repeated for all of the elevator cars. Thus, the elevator car having the most appropriate evaluation value is selected in the step A60—5.

A flow of the other call allotment algorithm, that is, the minimum predicted arrival time call allotment algorithm is shown in Fig. 17. The flow of Fig. 17 is substantially identical to that of Fig. 16 except a step A70—2. In this algorithm, in order to select an elevator car having a minimum evaluation value for the predicted arrival time to the hall call generating floor, a predicted arrival time Ti of the hall call generating floor i is loaded from the table of Fig. 12.

The processing flows of the predicted arrival time table processing program and the call allotment program, which are major programs of the operation control program, have thus been described. Beside those, the operation control program includes a multiple elevator car service processing program which serves a plurality of elevator cars to a crowded floor and a distributed waiting processing program which causes an elevator car to wait at a predetermined floor when a traffic demand is low. Those operation programs are known per se and not a part of the present invention, and hence the explanation thereof is omitted here.

The programs of the simulation software are now explained with reference to Figs. 18—23.

Fig. 18 shows a flow of the data collection program. This program is started periodically (for example, at every second), and when it has collected data for a predetermined time period (for example, ten minutes as shown in Fig. 11), it loads the data into the sampling data table SF21 of Fig. 13. Various data items may be collected. In the present program, three data items, destination traffic Cij, one floor running time tr of the elevator car and one stop time t_3 are collected.

In steps SA10 and SA20, the destination traffic Cij is collected. To this end, it is necessary to classify the passengers on the floor i by destination floor j. The destination floor j is determined by the number of passengers got into the elevator car on the floor i (which can be detected by a car weight sensor) and the car calls generated before the elevator car stops at the next floor. Thus, the passengers can be properly classified. Table 2 shows an example of the destination traffic Cij collected in this manner (where the number of floors of the building is eight). The summation ΣCij of the destination traffic Cij is equal to the number of passengers in the same time frame.

TABLE 2

Hall Call Generating Floor i	Destination Floor j: 1	2	3	4	5	6	7	8
1		3	2	4	5	3	2	5
2	4		1	0	2	4	2	1
3	4	2		0	1	3	2	2
4	3	1	1		2	0	0	0
5	6	2	0	3		2	3	2
6	2	3	2	0	2		4	3
7	4	1	1	0	2	4		3
8	5	2	2	0	1	3	2	

In steps SA30 and SA40, one floor running time data are collected. The number of floors which the elevator car has run and the running time are collected, and after the sampling, the running time is divided by the number of floors so that the one floor running time is computed. In steps SA50 and SA60, the number of times of stop of the elevator car and door opening time (stop time) are collected to compute the one stop time.

The data collected in the steps SA10—SA60 are processed in the manner described above after the sampling, and separately stored in an on-line measurement table and a time frame-classified table in the sampling data table SF21 of Fig. 13. The on-line measurement data table is shown with a suffix of "new" added to the item such as C new, Tr new and Ts new and the time frame-classified table is shown with a suffix "old" added to the item such as C old, tr old and ts old.

Fig. 19 shows a flow of the simulation data processing program which is periodically started (at every ten minutes from the timing of Fig. 11). The simulation data is predicted from the on-line measured data and the past data taking an appropriate combination variable γ into consideration. For example, for the destination traffic, it is computed by the following formula as shown in a step SB20.

$$Cpre = \gamma Cnew + (1 - \gamma) C\ old \tag{3}$$

Thus, the larger the combination variable γ is, the larger is the weight of the data of the on-line measured destination traffic. The predicted data is added with a suffix "pre".

Similarly, the predicted data trpre and tspre of the one floor running time and the one stop time are computed (step SB30). The data trpre and tspre are loaded to the tables Tr and Ts of the optimum operation control parameters SF29 shown in Fig. 13 (step SB40).

In order to carry out the simulation based on the predicted data computed by this program, the curve processing program (task) by the simulation shown in Fig. 20 is started (step SB50).

Fig. 20 shows a flow of the curve processing program by the simulation which is started in the step SB50 of Fig. 19.

The parameters of the simulation include an algorithm parameter As for selecting the call allotment algorithm and a control parameter α which is a weighting factor shown in the formula (1). The simulation is carried out for each of the parameters.

The simulation data such as the destination traffic is first set (step SC10) and the algorithm parameter is also set (step SC30). When the algorithm parameter As is 1, the long time waiting call minimizing call allotment algorithm is selected, and when As is 2, the minimum predicted arrival time call allotment algorithm is selected. Next, in a step SC30, the control parameter is set to carry out the simulation (step SC40). The control parameter α is, for example, 0, 1, 2, 3 or 4 as shown in Table 1 and Fig. 8.

The simulated results for the respective cases are stored by parameter (step SC60).

The mean waiting time and the power consumption are stored as the simulated result as shown in Table 1 although other evaluation items may be stored to prepare the curve tables.

When the simulation has been made for all of the cases, the optimum operation control parameter processing program (task) shown in Fig. 22 is started (step SC30) and the program ends.

A specific flow of the simulation execution program in the step SC40 is shown in Fig. 21. The

simulation program is mainly classified into an operation program for the elevator cars per se, for example, a running program and a door opening/closing program, and a managing program for efficiently managing the elevator cars such as a call allotment program and an elevator car distributed waiting program. Whether the simulated result is obtained with a high accuracy or not depends on the configuration of the simulation program. It is desirable to configure the program as equivalent to the elevator system as possible.

In Fig. 21, an initial value for the simulation is first set (step SC40—1) and then a loop processing is carried out for a predetermined simulation time period (for example, one hour) (steps SC40—2 to SC40—15). Then, a new passenger processing is carried out (step SC 40—2). The number of new passengers is computed based on the data of the predicted destination traffic Cpre of Fig. 13. When new passengers are detected in the new passenger processing, the generated hall calls are detected and the call allotment processing is carried out in steps SC40—3 to SC40—5. The call allotment processing is processed by a similar program to the call allotment program in the operation control program shown in Fig. 15.

When the call allotment program is completed, the car operation simulation is carried out. First, an elevator car running processing is carried out (step SC40—6) and it is checked if the elevator car position has reached a stop position. If yes, a processing in steps SC40—8 to SC40—13 is carried out.

When the elevator car position is at the stop position, it is checked if a service call such as a car call or an allotted hall call is present (step SC40—8), and if yes, the service call is reset and passenger getting on and off processing is carried out (step SC40—9). In order to evaluate the simulation result, the number of times of stop of the elevator car (because it is substantially proportional to the power consumption) and the waiting time data are collected (steps SC40—10 and SC40—11). Then, the door opening/closing processing is carried out (step SC40—12) to complete the processing for the elevator car. In the step SC40—8, if the service call is not present, the elevator car distributed waiting processing is carried out (step SC40—13).

After the above processing has been carried out for the predetermined simulation time, the mean waiting time and the power consumption which are the evaluation data resulting from the simulation are computed in a step SC40—16, and the program ends.

Fig. 22 shows a flow of the optimum operation control parameter processing program which is started in the step 80 of Fig. 20.

This program learns and computes an optimum operation control parameter to the group control of the elevator cars from the waiting time curve data and the power consumption curve data computed in Fig. 21 and the energy saving target value preset by the presetter.

The energy saving target value P_M is first inputted (step SD10). Based on the curve data table SF 26 derived from the simulation, the waiting time curve f_T and the power consumption curve f_P shown in Fig. 10 are computed by applying a predetermined interpolution. The predetermined interpolution may be a well known method for approximating a quadratic curve by three adjacent data.

When the curves f_T and f_P are computed, a minimum point operation control parameter α, and a minimum waiting time $f_T(\alpha_1)$ are computed from the curve f_T (step SD30).

Then, in a step SD10, it is checked if the input energy saving target value P_M is zero or not. If it is zero, the program jumps to a step SD80 and α_1 is selected as a candidate for the optimum operation control parameter α. On the other hand, if the energy saving target value P_M is not zero, an operation control parameter α_2 which meets the following equation is computed by using the power consumption curve f_P (step DS50)

$$f_P(\alpha_2) = f_P(\alpha_1) \times (15aP_M) \qquad (4)$$

The parameter α_2 corresponds to an operation control parameter which satisfied the energy saving target value P_M, for example, 10%.

In step SD60 and SD70, an upper limit of the waiting time is checked. It is checked if the waiting time $f_T(\alpha_2)$ at the point α_2 is within a predetermined limit T_{LMT} (upper limit), and if it is beyond the limit, another operation control parameter α_2 which meets the waiting time upper limit T_{LMT} is computed in order to prevent low serviceability.

In this manner, the parameters α_1 and α_2 are computed. For the curves f_T and f_P derived from the simulation by other algorithm, they are similarly processed, and the best ones, that is, the algorithm A_s and the operation control parameter α which present the minimum waiting time are selected (steps SD80 and SD90). The algorithm A_s and the parameter α thus selected assure the optimum operation control parameter to the elevator system.

One embodiment of the present invention has thus been described in detail. The advantages of the present embodiment are now discussed.

Firstly, since the building environment data which changes from time to time is on-line collected by the microcomputer M_2 and the elevator simulation is carried out based on the collected data to produce the waiting time curve and the power consumption curve and the optimum operation parameter is learned and computed from those curves and the target value, the group control system is

readily adaptable to the change of the building environment. Thus, the mean waiting time and the power consumption are greatly reduced.

Secondly, by utilizing the waiting time evaluation value and the stop call evaluation value as the call allotment evaluation function and changing the weighting factor α for those evaluation values, the control can be effected to minimize the mean waiting time and the energy saving operation is attained with a simple control.

Thirdly, since a plurality of call allotment algorithms are provided, a most appropriate one of the algorithms to a specific destination traffic can be selected by simulation. Thus, the mean waiting time can be more improved.

Fourthly, since the data are on-line collected, the parameters necessary to the elevator simulation can be learned and computed so that the precision of simulation is improved.

Fifthly, since the hardware configuration of the present invention has two microcomputers M_1 and M_2 in the group control system and the group control functions are distributed to those microcomputers, the response to the call allotment is fast and the on-line simulation can be attained and the system is adaptable to the change of the building environment in a short time.

Sixthly, since the serial data adapters SDA's are used for the communication between the microcomputers, the number of communication lines can be reduced and the reliability and economy of the system are improved and the loads to the microcomputers are reduced.

Another embodiment of the present invention is now explained.

In the previous embodiment, the mean waiting time curve and the power consumption curve have been discussed as the simulation curves. Alternatively, a long time wait curve may be utilized. The long time wait curve can be readily computed by considering a probability of occurrence of waiting time of longer than 60 seconds or waiting time of longer than 2—3 times of the mean waiting time. The long time wait curve may be used in place of or in combination with the mean waiting time curve. When they are used in combination, an upper limit long time wait is set in addition to the upper limit waiting time and the operation control parameters in the energy saving operation are limited by a logical OR function of those upper limits.

In Fig. 15, two call allotment algorithms are shown. Alternatively, additional call allotment algorithms may be used. However, as the number of algorithms increases, the number of cases of simulation increases so that the single microcomputer is insufficient to handle the cases. Accordingly, it is necessary to use a plurality of microcomputers or a high speed middle scale general purpose computer.

As described hereinabove, according to the group control system of the present invention, an efficient elevator service which is immediately adapted to the traffic demand can be provided.

CLAIMS

1. A control system for group-controlling elevator cars comprising;

a plurality of elevator cars serving to a plurality of floors;

hall call devices located on said floors for calling said elevator cars;

control means for controlling the operation of said elevator cars in accordance with an evaluation function having a variable parameter, to at least said hall calls;

simulation means for simulating said operation of said elevator cars to compute said variable parameter; and

means for supplying the computed variable parameter to said control means.

2. A control system for group-controlling elevator cars according to Claim 1 wherein said control means includes means for selecting an elevator car to serve to the hall call and means for allotting the selected elevator car to the hall call, and said evaluation function includes a function for selecting the elevator car to serve to the hall call.

3. A control system for group-controlling elevator cars according to Claim 1 wherein said variable parameter includes an coefficient parameter of said evaluation function.

4. A control system for group-controlling elevator cars according to Claim 1 wherein said variable parameter includes an evaluation function selection parameter for selecting one of a plurality of preset evaluation functions.

5. A control system for group-controlling elevator cars according to Claim 2 wherein said evaluation function includes a function of a waiting time to the hall call and a power consumed to serve to the hall call, and said variable parameter of said function includes a coefficient parameter for varying a weighting to said waiting time and said power consumption.

6. A control system for group-controlling elevator cars according to Claim 2 wherein said evaluation function includes at least an evaluation function having a waiting time to the already allotted hall call as a factor and another evaluation function, and said variable parameter includes an evaluation function selection parameter for selecting one of said plurality of evaluation functions.

7. A control system for group-controlling elevator cars according to Claim 2 wherein said simulation means includes a simulator equivalent to said elevator car selection means for receiving at least position information of the elevator cars and the call information to compute a specific variable parameter derived from simulating said elevator car selection means.

8. A control system for group-controlling elevator cars according to Claim 7 further comprising means for setting a control target value, and wherein said simulation means compares the simulation result with said control target value to compute a parameter which satisfies said control target value.

9. A control system for group-controlling elevator cars according to Claim 1 wherein said simulation means includes at least data collection means connected to said control means for collecting control information of said control means for a predetermined time period, means for computing simulation data based on the collected data and means for simulating the operation of said plurality of elevator cars based on said simulated data.

10. A control system for group-controlling elevator cars according to Claim 1 wherein said simulation means includes a simulator equivalent to the evaluation function having said variable parameter, produces a simulation curve based on the simulation results derived by sequentially switching said variable parameter, and computes an optimum parameter from said simulation curve.

11. A control system for group-controlling elevator cars according to Claim 1 wherein said control means is a computer and said simulation means is contained in said computer.

12. A control system for group-controlling elevator cars according to Claim 11 wherein said computer includes a plurality of computers for distributed-processing the operation of the elevator cars and the simulation.

13. A control system for group-controlling elevator cars according to Claim 12 wherein at least a first computer forms said control means for controlling the operation of said elevator cars and at least a second computer includes said simulation means.

14. A control system for group-controlling elevator cars according to Claim 13 further comprising means for exchanging data between said first computer and said second computer, and wherein said first computer controls the operation of said elevator cars in accordance with a variable parameter computed by said second computer.

15. A control system for group-controlling elevator cars according to Claim 14 wherein said second computer includes a simulator equivalent to said control means, and when said first computer fails, said simulator of said second computer is activated to continue the control to the operation of said elevator cars.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1983. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.